



MIND THE GAP
WE ASSESS THE
NEED FOR A MIDDLE
OF THE MARKET JET
ANALYSIS P22

CYCLONE STRIKES
Canada ends wait for
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air force accepts first six
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heavy transporter **10**

FLIGHT

INTERNATIONAL

From **FG** Flightglobal

30 JUNE-6 JULY 2015



ENVIRONMENT

AVIATION'S ECO WARRIOR

How Boeing is using an aged 757 to test the
emission-beating technologies of tomorrow

£3.50



France will take the spotlight as “feature country” at Singapore

Singapore Airshow 2016 will welcome France as the Feature Country in the fifth edition of the show, scheduled to take place from 16 to 21 February 2016, at the Changi Exhibition Centre.

The Feature Country series, which made its debut at the 2014 Airshow, was developed as a permanent feature to enable the companies exhibiting within the pavilion to leverage on the Singapore Airshow as a strategic platform; lending support to businesses of the Feature Country and enabling them to tap the opportunities in the Asia Pacific region and beyond.

The French Pavilion will be located at a prominent spot within the exhibition hall. Participating exhibitors will have access to a dedicated “Deminar” area – a demonstration and seminar area for research institutes and universities to showcase their latest technologies and innovations. In addition, business meetings between the French Pavilion exhibitors and VIP delegations will also be specially facilitated.

“Being a Feature Country at the Singapore Airshow 2016 gives us the unique platform to bring together our latest and best aviation technologies to meet the growing appetite for innovation in the Asia Pacific aviation sector, translating into real business deals for our French companies,” said Emeric D’Arcimoles, the Paris Air Show Chairman and Chairman of the



International Committee of Groupement des industries françaises aéronautiques et spatiales.

The French aerospace, defence and security industry is worth 47.9 billion Euros, and specifically, out of which 30.4 billion Euros is contributed by exports. This shows that France is well-placed to leverage its Feature Country platform to bring its latest innovations to the region's top decision-makers converging at Singapore Airshow 2016.

This comes at an opportune time in the Asia Pacific aviation industry, where the com-



mercial aerospace sector is expected to set new records for aircraft production in 2015, off the back of the accelerated replacement cycle of obsolete aircraft and growing passenger travel demand in the Asia Pacific region. Countries in the region are also increasing defence spending to equip their militaries with modern defence platforms and technologies.

Reflecting this growth is the continued expansion of reach and impact of each new edition of Singapore Airshow. The 2016 show is already 80 per cent committed, with specialised spaces like the Aerospace Emerging Technologies Zone, the Training and Simulation Zone and the introduction of the Business Aviation Zone, to further spawn business development opportunities.

For more information about the Feature Country programme, please contact Mr Danny Soong at dannysoong@experiaevents.com or +65 6595 6123.

Hosted Buyers Programme offers new partnership opportunities

Buyers seeking specific products and solutions at Singapore Airshow 2016 can now leverage on the Hosted Buyers business matching programme to source



new contacts and explore new ventures. Accorded with a complimentary 4-day Hosted Buyer Pass and exclusive hospitality arrangements during the trade days, each eligible buyer will enjoy a hassle-free business meeting experience as pre-scheduled meetings are facilitated with exhibitors that match their requirements.

For more information about the Hosted Buyers Programme, please contact Ms Liliane Lye at lilianelye@experiaevents.com or +65 6595 6126.

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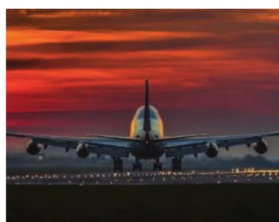
COVER IMAGE

Boeing provided this aerial image of its former TUI 757 ecoDemonstrator aircraft, which it has been using to evaluate a number of green technologies **P7, 24**



BEHIND THE HEADLINES

Dan Thisdell made himself at home at London's Royal Institution, where OneWeb signed a contract for Virgin Galactic to perform 39 flights of its LauncherOne system from as soon as 2017 (**P6**). The deal will put a series of microsattellites into orbit



NEXT WEEK ATM

We check the progress of Europe's SESAR air traffic management initiative. Plus, a full Virgin Galactic update

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Canada accepts its first Sikorsky CH-148 Cyclones **P9**. Boeing's plans to increase 777X output revealed **P14**



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IMAGE OF THE WEEK

A Boeing F/A-18E Super Hornet from the US Navy's VFA-195 fighter squadron – the “Dambusters” – prepares to land on the aircraft carrier USS *George Washington* near Guam on 8 June. The unit is operating with the service's fifth carrier air wing, “supporting security and stability in the Indo-Asia-Pacific region”

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US Navy

THE WEEK IN NUMBERS

3%

Flightglobal dashboard

Two years of talks won El Al workers this salary increase – and a bonus of up to 1% if the carrier makes a \$30m profit

\$1.46bn

Flightglobal dashboard

A record number of passengers – 64.7m – helped Hong Kong airport authority lift profits by 13.8% in 2014-15

50

Quantum Investment Bank

The biggest leasing deal in its history will see Saudia get 30 A320 and 20 A330-300 aircraft; value undisclosed

QUESTION OF THE WEEK

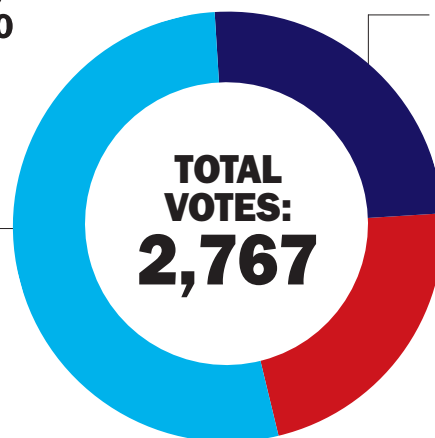
Last week, we asked: **As it spars with Airbus over 757 replacement, will Boeing...** You said:

53%

Launch 'MoM' product

25%

Park the concept



22%

Wait for demand to rise

This week, we ask: **Future of Virgin Galactic...**

☐ Space tourism ☐ Satellite launcher
☐ Both ☐ No future

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The Power of Flight

Perfect timing

For the first time in a while, the new man in Boeing's hot seat can assume control without a backdrop of scandal or spiralling production disasters to contend with – but challenges remain

Jim McNerney's announced plan to step aside as chief executive affords Boeing a smooth leadership transition at the top of the company for the first time since 1996.

McNerney's hand-picked successor, Dennis Muilenburg, has been learning the ropes in Chicago since 2013, when he was promoted from head of the defence and space division to chief operating officer and president.

Boeing's leadership transitions haven't always proceeded so smoothly. McNerney's two most recent predecessors – Harry Stonecipher and Phil Condit – were forced to leave the company in the wake of personal and professional scandals. McNerney's rise from Boeing board member and chief executive of industrial products firm 3M was both rushed and poorly timed, coming mid-stream during the neglectful development of the 787 technology and supply chain.

Despite a two-year stint in Chicago, he arrives with none of his predecessor's baggage

Muilenburg has his share of challenges to overcome, but there is no immediate fire-fighting required.

The commercial aviation business has reached a tipping point, following several years of amassing a historic backlog of orders for new and existing aircraft. The challenge now is to keep the development programmes on track while not breaking the production system.

The defence business is in a different place. A contract award for the long-range strike bomber is due shortly. That decision is expected to transform the industrial landscape for combat aircraft production in the USA, with either Northrop Grumman or Boeing the



Don't annoy him

odd man out in a duopoly with Lockheed Martin.

Muilenburg has no fewer problems and opportunities than his predecessor, but he has the rare luxury – at Boeing, anyway – of coming into the job with a head-start and with the pace of events not dictated by scandal.

Despite a two-year stint in Chicago, he also reaches the top post with little of McNerney's baggage from dealings with Boeing's largest unions.

McNerney likely considers those clashes as a badge of honour. Extracting major concessions probably lifted a little pressure on Boeing's margins, but left toxic relations with workers. The 787 experience made Boeing realise that outsourcing is not the answer to the company's labour problems. Now it is going to find out how much work can be spread to non-unionised sites.

Here again, Muilenburg's timing is impeccable. With the difficult pension issue resolved in early 2014, no such emotionally-charged subjects are likely to be laid on the table when the next round of contract bargaining with its workforce begins. ■

See This Week P7

Jumping forwards

Over the course of little more than one week, the UK's carrier-based aviation ambitions have at last become almost tangible.

The phrase "capability holiday" has previously been used to describe the situation where the Royal Navy has been unable to deploy embarked fixed-wing strike assets since the BAE Systems Harrier GR9's retirement in December 2010. This measure remains one of the most savagely-criticised decisions of the last Strategic Defence and Security Review, with some even having called for a revival of production of the venerable "jump-jet", in preference to the Joint Strike Fighter.

While the so-called "senior service" is still some years away from seeing a Lockheed Martin F-35B soar

from the deck of the HMS *Queen Elizabeth* – even in training, let alone anger – advocates of "carrier strike" should be heartened by the sight of the short take-off and vertical landing type using a "ski-jump" ramp for the first time. Seeing this key feature of the new model, as tested at the US Navy's Patuxent River facility in Maryland, will revive fond memories in the UK.

Achieved just days before lead vessel the *Queen Elizabeth* had one of her diesel engines started for the first time, the flight provided a welcome glimpse of what will become a formidable combination.

How formidable? That will depend on the outcome of the UK's next defence review, due in October. ■

See Defence P17



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BRIEFING

AIRBUS EYES HAMBURG FOR MORE A320 CAPACITY

PRODUCTION Hamburg's Finkenwerder plant is the most likely site for a new Airbus A320 final assembly line if the airframer opts to raise monthly production rates beyond its commitment of 50. Airbus chief executive Fabrice Brégier, speaking during the Paris air show, said the company would take a decision on an increase this year, but reiterated the need to ensure that its supply chain could cope. At higher rates, the company "would need another [final assembly line]", he said, adding: "Probably we'd put it in Hamburg."

SLYUSAR TAKES ROLE ON AEROFLOT BOARD

APPOINTMENT United Aircraft Corporation (UAC) president Yuri Slyusar has been appointed to the board of Russian flag-carrier Aeroflot, and says he wants to "promote co-operation" between the carrier and the manufacturer. Aeroflot has orders for UAC company products including the Irkut MC-21 and Sukhoi Superjet 100.

GHANA JOINS SUPER TUCANO CUSTOMER LIST

ORDER Ghana has signed a contract to acquire five Embraer A-29 Super Tucano turboprops for "advanced training, border surveillance and internal security missions". Also including pilot training and logistics support, the sale was announced by Embraer on 19 June.

KUWAIT WELCOMES 212-SEAT A330-200

ARRIVAL Kuwait Airways has received its first Airbus A330-200, with the aircraft configured with 17 first-class, 30 business-class and 165 economy seats. The airline will introduce another four of the leased Rolls-Royce Trent 700-engined type as part of a fleet renewal.

CROATIA GETS ACE OFFER FROM ISRAEL

FIGHTERS Israel is offering Croatia some of its Lockheed Martin F-16A/Bs upgraded to the ACE configuration, as replacements for its Mikoyan MiG-21 fighters. An Israel Aerospace Industries-led team would provide Elta Systems EL/M-2032 fire control radars and new cockpit equipment, and could also possibly add Rafael's Python 5 air-to-air missile. The USA is offering Zagreb second-hand F-16s, while Sweden is promoting refurbished Saab Gripen C/Ds.

FIRST ARRIVAL FOR FLY BAGHDAD

DELIVERY Iraqi start-up operation Fly Baghdad has received its first aircraft – a Bombardier CRJ200 bearing the registration YI-BAH. The airline, which says it is "launching soon", is also recruiting for cockpit and maintenance crews for the Airbus A320 and Boeing 737-800.

CANBERRA SEEKS MISSILES FOR GROWLER FLEET

REQUEST Australia has received approval from the US State Department to purchase 14 Raytheon AGM-88B high-speed anti-radiation missiles and 16 ATK AGM-88E advanced anti-radiation guided missiles. Worth a potential \$69 million, the request is likely to be related to Canberra's acquisition of 12 Boeing EA-18G Growler electronic warfare aircraft, which have entered production.

LAST A321 ARRIVES FOR THOMAS COOK

FLEET Thomas Cook has taken delivery of its last of nine Airbus A321s from US operating lessor GE Capital Aviation Services. The narrowbodies represent part of a fleet renewal and modernisation programme that commenced with a first delivery in October 2014. Flightglobal's Ascend Fleets database shows the carrier as having 54 aircraft, including 25 A321s.

SPACEFLIGHT DAN THISDELL LONDON

Virgin Galactic is boosted by deal

Launcher business nears lift-off with contract to loft Airbus Defence & Space-built satellites for internet firm OneWeb

Virgin Galactic's bid to enter the rocket launching business was boosted on 25 June with its first contract for 39 flights of its LauncherOne system, starting as early as 2017.

The deal – including another 100 options – is with UK-based OneWeb, which plans to orbit 900 Airbus Defence & Space-built microsatellites of less than 150kg (331lb) each, to provide affordable broadband internet to rural areas around the world from 2019.

Most units will be launched by Arianespace on 65 Soyuz flights from Kourou, French Guiana and Baikonur, Kazakhstan – with each rocket capable of deploying about 36 satellites.

The LauncherOne flights will put one to three of the satellites into low-Earth polar orbit, with a focus on filling in any gaps in the constellation.

Soyuz flights will start in 2018, and OneWeb also has taken options on flights on Ariane 6, the European heavy-lifter being developed by Airbus and Safran to replace Ariane 5 from 2020.

Virgin Galactic chief executive George Whitesides tells *Flight International* that rapid response is the key to the OneWeb deal: "What we'll shine at is replenishment." OneWeb founder Greg Wyler, presenting the venture in London, said replacing a faulty satellite within 24h could be crucial.

Whitesides says LauncherOne, which is to be air-dropped from the same WhiteKnightTwo carrier aircraft that launches Virgin Galactic's suborbital passenger craft, will test fly in 18 to 24 months.

Rockets will soon go into production in a purpose-built factory in Long Beach, California. ■

AWARD

Flight scoops aviation accolade

Flight International won the prestigious award for best international publication at the annual Aerospace Media Awards event in Paris on the opening day of the Le Bourget show.

Picking up the trophy from (*left to right*) comedian and host Fred MacAulay and Natalia Zelentsova of sponsor Russian Helicopters were publisher Stuart Burgess, deputy editor Dominic Perry, aer-

ospace reporter Michael Gubisch, former editor and *Flight Daily News* editor Murdo Morrison and executive director content Max Kingsley-Jones.

"Winning this award is a real honour," says editor Craig Hoyle, "and a testament to the hard work of the entire Flightglobal team." The Aerospace Media Awards are held each year at Paris and Farnborough. ■





Airbus toys
with growing
A350 family
THIS WEEK P8

THIS WEEK

TECHNOLOGY STEPHEN TRIMBLE WASHINGTON DC

Scrapyard to be backdrop for 757's final green trials

Energy-harvesting windows, green diesel biofuel and a 3D-printed flightdeck monument are three technologies that will be tested on the last series of flights of a TUI Group-branded Boeing 757 ecoDemonstrator destined to be dismantled by the end of July.

Boeing has partnered with the Aircraft Fleet Recycling Association to disassemble the 1990-built 757 (N757ET) at the conclusion of the tests. In the pioneering spirit of the ecoDemonstrator programme, however, the process will serve as an opportunity to validate a variety of new options for recycling the aircraft's various materials and systems.

"We are going to recycle the heck out of the airplane," says Jeanne Yu, Boeing's environmental performance director.

Until then, the 757 ecoDemonstrator will continue a new programme of flight tests following on from a first series concluded two months ago.

The first series of flights on the



A second round of flight tests will focus on the use of biofuels and energy harvesting technologies

757 focused on several drag-reducing technologies, such as an active flow control system mounted on a tail fin, insect "phobic" coatings on the leading edge of the right wing and a laminar flow-protecting Krueger flap on the left wing.

Beginning on 17 June, the second test phase kicked off with a

flight from Seattle to NASA's Langley Research Center in Hampton, Virginia, using a bio-fuel blend composed of 95% petroleum jet fuel and 5% sustainable biodiesel.

Another trial is focused on reducing the weight and power requirement for the electrically dimmable windows fitted on the

787 through harvesting energy from both the sun and the temperature differential between the inner and outer window panes.

Finally, the 757 ecoDemonstrator flightdeck also features an aft aisle stand 3D printed using scrap carbonfibre material recovered from the 787 production system. ■

See Cover Story P24

LEADERSHIP STEPHEN TRIMBLE WASHINGTON DC

Boeing looks inwards for new leader

Incoming boss Muilenburg inherits stable business, but challenges remain on programme execution and labour relations

Former defence executive Dennis Muilenburg will become Boeing's 11th chief executive on 1 July, succeeding Jim McNerney after a pivotal decade of record growth, programme development crises and clashes with labour unions.

The succession plan returns a long-time Boeing employee to the chief executive suite for the first time since the forced resignation of Phil Condit in 2004.

Muilenburg, 51, joined Boeing's defence division in Seattle 30 years ago and worked on a succession of major programmes, including Boeing's contribution to the Lockheed Martin F-22 Raptor, before entering the ranks of the company's top programme managers. Muilenburg led the ill-

fated Future Combat Systems (FCS) effort for Boeing before being elevated to run the entire defence and space segment.

In 2013, McNerney selected Muilenburg to come to its corporate headquarters in Chicago to serve as chief operating officer at the depths of the battery crisis that grounded the global 787 fleet for more than four months. McNerney also gave up his title as president of the company, transferring the role to Muilenburg in a move widely seen as anointing him as his successor.

Muilenburg now inherits a company with a historically high market value and order backlog, but facing pressures on execution, defence strategy and relations with its workforce.

"Our company is financially strong and well positioned in our markets," says Muilenburg.

Several commercial projects remain in development while the biggest prize on the defence side – the US Air Force's coveted contract to build 80-100 next-generation bombers – is scheduled to be decided later this summer. A Boeing-led team with Lockheed is competing against Northrop Grumman for the long-range strike bomber requirement.

Boeing selected McNerney in 2005 amidst a leadership crisis. His two previous predecessors – Condit and Harry Stonecipher – had been forced out in scandals over only a two-year period. McNerney was then chief executive

of 3M but familiar with Boeing's operations as a member of the company's board and past executive for supplier General Electric.

Annual revenues increased 73% to \$90.8 billion over the decade that McNerney led the company, Boeing says. But he also presided over a period of troubled development programmes – such as the 787 – along with highly divisive relations with the company's labour unions.

The 787 programme entered service three years late and faced deep reliability problems. Although production has stayed mostly on track, that has come at a steep cost, as deferred costs attributed to the programme approach \$30 billion with no apparent end in sight. ■



PROGRAMME DAVID KAMINSKI-MORROW PARIS

Airbus toys with growing A350 family

Airframer scopes out market demand for an aircraft larger than the in-development 366-seat -1000 to tackle rival 777-9X

Airbus is sounding out operators to determine whether there is a realistic demand for an aircraft larger than the A350-1000.

While the discussions, and its own internal studies, are only preliminary, they give the clearest indication so far that the airframer is exploring the potential of further development of the family.

The A350 was originally envisioned as a three-aircraft family centred on the -900, with a -1000 stretch and a shrunk -800. But the -1000 has been redesigned to provide greater capability while the -800 has effectively been abandoned in favour of re-engining the A330.

Chief operating officer for customers John Leahy, speaking during the Paris air show, said that the -900 was no longer the A350's centre of reference, but that this middle point has "moved toward the -1000".

Rather than a "double-stretch" strategy – about which he has expressed scepticism – Leahy says further development of the -1000 might be closer to "one and a half".

Revamp of the -1000 in 2011 has already resulted in the modification of the A350's wing, a higher maximum take-off weight, and changes to the Rolls-Royce Trent XWB engine to deliver additional thrust.

The degree of flexibility available to Airbus to enhance the -1000's design without substantial alterations will form part of the studies.

But Leahy stresses that the airframer's priority is to explore whether there is any genuine demand for an upgrade.

"You have to be sure the market is asking for 40 more seats," he says, reiterating his belief that Boeing is offering 400 seats on the 777X – against 366 on the A350-1000 – to keep the seat-mile mathematics in line with its rival's.

Airbus already has projects in progress aimed at finding ways to raise capacity on the A350 family by up to 20 seats within the next five years.

But Leahy says that the possibility of a development beyond the -1000 is a subject of early discussions with operators as well as internal analysis. ■



A further stretch of the developmental twinjet is under evaluation

PROPOSAL

Tentative A380 plan could add 54 seats

A proposed stretch of the A380 which is being floated to airlines would probably amount to four frames on the current -800 variant, Airbus has indicated.

While the proposal is only preliminary, chief operating officer for customers John Leahy said at the Paris air show that the mooted "mini-stretch" would give room for around three more rows in the economy-class cabin and one in business-class.

This would probably allow accommodation of another 36-54 seats, depending on the precise upper- and lower-deck configuration. Airbus puts the typical seating capacity of the -800 at 544 seats.

Modification would stretch the fuselage by around 2.5m (8.2ft), taking total aircraft length to 75m.

Airbus is considering the stretched model – a more conservative development than the original 650-seat A380-900 – in parallel with a possible re-engining programme.

The airframer remains confident of the A380's prospects, saying its latest 20-year forecast predicts a market for around 1,200 high-capacity passenger aircraft.

Leahy is confident of additional A380 orders by the end of the year, saying he is negotiating with "several customers" including possible new operators, and is aiming for sales of at least 25 of the type this year. ■

TRANSPORTS CRAIG HOYLE LONDON

Atlas deliveries resume with handover to France

The French air force's seventh of an eventual 50 A400M tactical transports has touched down at its Orléans-Brice air base, as the service gets ready to support airdrop testing involving the Airbus Defence & Space type.

Accepted by the DGA defence procurement agency in Seville, Spain, on 19 June, aircraft MSN19 is the first French air force example to be received in a new configuration capable of performing the airdrop of equipment.

Speaking at the Paris air show on 17 June, France's A400M programme manager said a six-week programme of airdrop testing in-

volving the type will start soon, having been postponed following a fatal accident in Spain on 9 May.

To be performed using one of Airbus's "Grizzly" test aircraft, the work will involve personnel from several customer nations. "Our

aim is to clear the capability early in 2016," the French official says.

The acceptance of the latest French air force aircraft happened one day after Airbus received approval from Spain's DGAM authority to resume pro-

duction deliveries of the "Atlas". That move represented the "lifting of all remaining flight restrictions on new production aircraft", the company says.

Another A400M, which had also been poised for delivery prior to the crash, will be handed over "in a matter of days", Airbus says, "with a number of others to follow in the coming weeks". All of these examples are awaiting acceptance by the UK Royal Air Force.

Airbus is still targeting delivery of at least 13 aircraft this year, although that could rise to as many as 17, it says. ■



The French air force will eventually operate a total of 50 A400Ms



CFM aims for new heights with Leap
AIR TRANSPORT P10

PROCUREMENT JAMES DREW WASHINGTON DC

First Cyclones ready at last for Canadian air force duty

Acceptance of first six CH-148s marks beginning of the end for lengthy procurement saga

The Royal Canadian Air Force has accepted its first six Sikorsky CH-148 Cyclone maritime helicopters, marking a major step forward in a protracted programme to replace its aged fleet of Sikorsky CH-124 Sea Kings.

Speaking during an acceptance ceremony at Shearwater air base in Nova Scotia on 19 June, defence minister Jason Kenney said two more of the rotorcraft are due to arrive at the site in December, with all 28 examples to be in place by 2021.

The Block I Cyclones were

delivered in accordance with a revised schedule agreed with Sikorsky in January 2014. The new type will fully replace the Sea King's operational capabilities from 2018, the air force says.

Cyclones conducted 60 test missions from the frigate HMCS *Halifax* over a six-month period concluding in May, consisting of about 300 take-offs and landings, and enough pilots, aircrew and maintainers have been trained to meet early operational objectives.

Kenney says the helicopters

meet the operational requirements outlined in the amended deal with Sikorsky, and are "ready for full utilisation now".

The total value of the Cyclone programme is C\$7.6 billion (\$6.2 billion), including C\$1.9 billion for development and production of 28 helicopters and C\$5.7 over 20 years for in-service contractor support. Launched in 2004, the activity has been beset by technical issues, delays, cost growth and contract revisions. It also followed an earlier replacement project, which was aborted in 1993 at a total cost of about C\$500 million.

Derived from Sikorsky's civil S-92, the twin-engined, medium-lift Cyclone will perform ship-board maritime surveillance and rescue operations. Being provided by an industry team also including General Dynamics Canada and L-3, the fleet will replace 27 Sea Kings, the oldest of which entered service in 1963 and are the oldest aircraft in Canada's air force inventory.

"The Cyclone has been a complex procurement – one that has seen its share of challenges," says public works and government services minister Diane Finley. "In fact, this procurement has had a torturous history." ■



Canadian Forces

The S-92 variant has completed extensive ship-based trials

TESTING ARIE EGOZI TEL AVIV

Unmanned AirMule to be unleashed

Urban Aeronautics is continuing ground tests on its first AirMule prototype in preparation for free flights with the unmanned air vehicle, which are scheduled to start during the third quarter of this year.

Current activity includes installing a radar altimeter and flight termination system, as required by the Civil Aviation Administration of Israel. The verti-

cal take-off and landing type's communication and ground control station systems are also being updated.

Tethered tests recently involved assessing various aerodynamic refinements. "These have shown promise for increased payload capacity in future AirMule derivatives," says Urban Aeronautics president Rafi Yoeli.

The main structure of an iden-

tical second prototype is almost complete, and the company "will soon begin installation of gearboxes, engine, rotors and avionics", Yoeli says.

Demonstrations for potential customers will take place in 2016, with Urban Aeronautics now preparing subsystem specifications and identifying potential suppliers for full-scale development and production. ■



Korea Aerospace Industries

LCH design is based on H155

DEVELOPMENT
GREG WALDRON SINGAPORE

Seoul rotorcraft ambitions get set for take-off

South Korea's aerospace ambitions have been advanced through the signature of contracts related to the Korea Aerospace Industries (KAI) light civil helicopter (LCH) and light armed helicopter (LAH).

The two contracts value the programme at KRW1.6 trillion (\$1.4 billion), says KAI, which signed the deals with the Korea Evaluation Institute of Industrial Technology and the Defense Acquisition Program Administration. This total also includes "the investment of industrial participants", it adds.

In March, KAI announced that it had selected the Airbus Helicopters H155 to form the basis of the LCH and LAH, which are expected to enter service in 2020 and 2022, respectively.

"Upon completion of the development, KAI will become the sole company producing the LCH/LAH, since Airbus Helicopters agreed to cease manufacturing the H155 and H365 series," says KAI. "For the promotion in the global market of the LCH/LAH, KAI and Airbus Helicopters have committed to jointly collaborate."

The two companies previously worked together to develop the Korea Utility Helicopter (KUH)/Surion, which is now in service with the nation's army.

"Both companies are confident in the success of the LCH and LAH projects from their experience in mutual collaboration in the KUH project," adds KAI. ■



PROPULSION MARK PILLING PARIS

CFM aims for new heights with Leap

Partners GE and Snecma build new “Pulse” assembly lines to meet bulging orderbook for civil powerplants

CFM International joint-venture partners GE and Snecma are in the midst of a huge global industrial effort to achieve an unprecedented scale of civil engine production, with Leap output set to go from zero to over 1,800 powerplants annually by 2020.

“For us the subject is production,” said CFM president Jean-Paul Ebanga at a Paris air show media briefing. “It’s all about the coming ramp-up of Leap and the transition from the CFM56 to Leap.”

There is a bulging Leap orderbook – some 2,717 sales of CFM’s new model were booked in 2014 alone, with another 442 added in the period to 31 May this year and a further 500 during the Le Bourget show.

Allied to that are the highly demanding production rates for the Airbus A320neo and Boeing 737 Max that need to be satisfied.

CFM partners GE Aviation and Snecma are building so-called “Pulse” assembly lines for the

Leap – similar to those created for the current CFM56 engines – in order to be capable of supporting the ambitious build rates.

Snecma’s two new lines at Villaroche in France will come on stream in January 2017 and early 2018, says the company. Meanwhile, GE is constructing the other main Leap line, a \$100 million investment due to open this year, at West Lafayette in Indiana, says CFM executive vice-president Allen Paxson.

In addition, Paxson explains, there will be surge capacity for



CFM executives Allen Paxson, Jean-Paul Ebanga and François Bastin

Leap final assembly at GE’s factory in Durham, North Carolina.

The rapid build-up of Leap production up to 2020 is at the limit of what CFM can achieve. “Today, we are very constrained on the rate at which we can ramp up production,” says Paxson. CFM is talking to Airbus and Boeing

about the implications for engine production if either or both chose to increase the rates of their individual narrowbody output from 50 or so towards 60 per month.

“Everything is possible with the right amount of time,” says CFM executive vice-president François Bastin. ■

TECHNOLOGY

Labours of Herakles pay off as CMC exhaust cone debuts

Air France has started flying an Airbus A320 with a ceramic matrix composite (CMC) exhaust cone, the first introduction of such technology on an in-service commercial airliner.

Structures made from ceramic matrix composite are substantially

lighter than their metallic equivalents and are capable of withstanding higher temperatures.

French firm Safran’s Herakles division designed the cone for the CFM International CFM56 engine.

After some three years of testing, the European Aviation Safety Agency

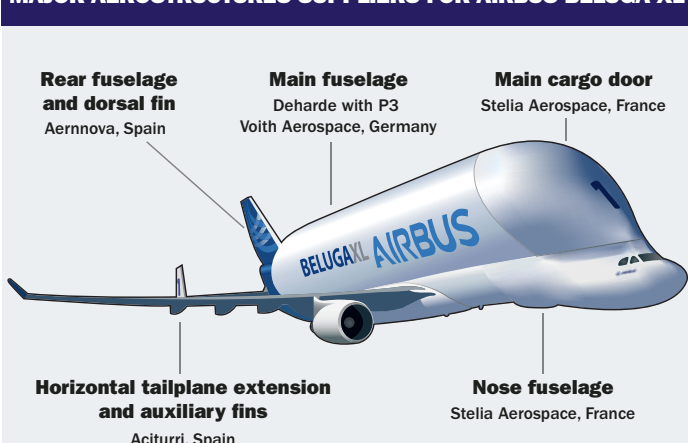
approved the component on 22 April, Safran disclosed at the Paris air show.

It began flying on the Air France A320 on 16 June. “This is the first time in the world that a CMC part has flown on a jetliner in commercial service,” says Safran. ■

FREIGHTER DAVID KAMINSKI-MORROW PARIS

Airbus reveals suppliers to build its bigger Beluga

MAJOR AEROSTRUCTURES SUPPLIERS FOR AIRBUS BELUGA XL



SOURCE: Airbus

Airbus’s new A330-based Beluga transport will be 6m (20ft) longer than the A300-600ST that is currently used for logistics support.

The airframer disclosed the additional specification of the jet as it selected a number of suppliers to produce components for the type.

The specification states that the new aircraft – designated the Beluga XL – will have its characteristic nose fuselage and main cargo door designed and built by Stelia Aerospace.

The rear fuselage and fin will be provided by Aernnova, while the horizontal stabiliser exten-

sion, plus the vertical auxiliary fins, will be developed and supplied by Aciturri.

Airbus, which disclosed the details at the Paris air show, says the responsibility for the distinctive fuselage will be given to a partnership between Deharde and P3 Voith Aerospace.

The airframer says the design concept for the Beluga XL is “similar” to that of the A300-600ST, with a lower-set cockpit, enlarged fuselage and modification of the empennage. There will be a “large re-use” of current A330 components, it adds.

“Further suppliers are being selected,” says Airbus. ■



Thailand resolves
to clear ICAO audit
AIR TRANSPORT P12

SAFETY DAVID KAMINSKI-MORROW LONDON

Signage played part in 747 accident

BA pilots suffered “loss of situational awareness” but directions at Johannesburg airport were inadequate, says report

Poor signage and lighting at Johannesburg contributed to a British Airways Boeing 747-400 crew’s inadvertently following a narrow taxiway before the jet’s wing sliced into a service building.

But the inquiry into the accident, which demolished part of the building and led to the 747 being written off, also says that the pilots did not brief the taxi route and were unaware of a caution note in the aerodrome chart warning of potential confusion risks.

South Africa’s civil aviation authority says that the pilots suffered “loss of situational awareness” while taxiing in darkness for runway 03L ahead of departing for London Heathrow on 22 December 2013.

The crew had expected the aircraft to be facing north after pushback and had discussed a taxi route that would take the 747 out of the apron area, before turning south along taxiway A – which ran parallel to the runway.

But the pushback clearance instead told the crew to face south. While this instruction was normal, the crew had not expected it, and queried the clearance among themselves before confirming it with air traffic control.

After engine start, the crew was cleared to proceed along a

different taxi route, following taxiway B. This took the aircraft south, out of the apron, but after 600m it crucially curved to the left at a junction. Not following this curve, but continuing straight ahead, would take the aircraft along the narrow taxiway M with buildings in close proximity.

Despite the different taxiing instruction the pilots “did not alter their expectation and review the new route”, says the South African CAA, adding: “If they had, they might have foreseen the conditions on [taxiway B].”

The report states that a review might have resulted in the crew’s discussing the critical curve at the junction and prepared them to look for cues.

But the inquiry also determined that signage at the junction where taxiways B and M diverged was not adequate to warn crews. Some taxiway B centre-line lights had not been functioning, it adds, while continuous blue edge lights feeding into taxiway M added to a “false perception” by the captain that the aircraft was still on taxiway B.

Some 10s before the collision the first officer, who was handling the aircraft, expressed concern about the width of the taxiway. The 747 was travelling at

14.5kt (27km/h) when its starboard wing carved into the Bid-Air Services building, injuring four employees.

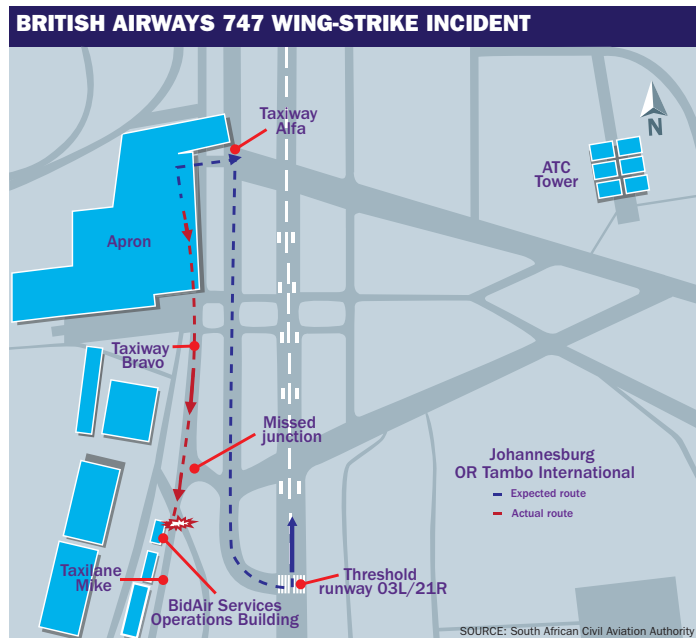
Although Johannesburg’s advanced surface-movement system detected the aircraft’s encroachment on to taxiway M, it had not been fully commissioned and monitoring was “solely at [air traffic controller] discretion”.

Around 1,000kg (2,200lb) of fuel spilled from the 747’s tanks, BA estimated, although the investigation was unable to calculate a precise figure. None

of its occupants was injured.

The 1990-built aircraft (G-BNLL) sustained extensive damage to its wing and was subsequently parked and broken up.

South Africa’s CAA points out that the circumstances were similar to those of an incident involving another British Airways 747-400 (G-BYGA) at the same airport in April 2005. The crew had entered the narrow taxiway M after becoming confused by unclear markings and the aircraft, unable to manoeuvre, had to be pushed out. ■



SOURCE: South African Civil Aviation Authority

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ICAO performed an audit of the country's regulator in early 2015

REGULATION GREG WALDRON SINGAPORE

Thailand commits to put safety first

Country misses mid-June deadline to address concerns over procedures for approving air operator certificates

Thailand has reaffirmed its commitment to satisfy ICAO concerns about air safety in the country, following its failure to meet an 18 June deadline to resolve issues raised by an audit earlier this year.

In a report carried by Thailand's state news agency, transport minister Prajin Juntong said the country's efforts to resolve ICAO's concerns have fallen short, but that efforts continue to restructure the country's Department of Civil Aviation.

Indications are that it has until October or November to resolve the issues, and local media suggest it will first face a 25 June inspection by European Aviation Safety Agency officials.

ICAO's audit earlier this year identified concerns around the country's procedures for approving air operator certificates, says ICAO.

Deputy transport minister Ark-

hom Termittayapaisith has visited ICAO to discuss the matter, and Thailand has also held discussions with South Korea, Japan, China, and Australia. Japan and South Korea have been especially aggressive in response to ICAO's concerns, curtailing charter services by Thai carriers and the launch of new flights.

Thailand's failure to meet the 18 June deadline also saw it receive a "red flag" from ICAO, adding it to a list of states including Angola, Botswana, Djibouti, Eritrea, Georgia, Kazakhstan, Lebanon, Malawi, Nepal, Sierra Leone and Uruguay.

Curiously, of the seven audit criteria used by ICAO, Thailand rates above the global average for all but two: organisation and operations.

For organisation, Thailand is at 46.2%, versus a global average of 64.2%, while for operations, it is in line with the global figure of 70%. ■

STRATEGY MICHAEL GUBISCH WARSAW

LOT considers A330neo as EC fleet limits expire

Polish flag carrier LOT plans to double its fleet by 2020 under a newly launched expansion strategy and is studying the Airbus A330neo as a potential second long-haul type to operate alongside the Boeing 787.

Capacity restrictions imposed on the Warsaw-based Star Alliance carrier by the European Commission are set to expire by the end of 2015, and LOT aims to operate "at least 70 to 80" aircraft by 2020, it says. But the expansion will require fresh capital from either external investors or a share issue, says chief executive Sebastian Mikosz.

LOT's fleet comprises 41 aircraft, comprising three 737-400s, four 787-8s, 25 Embraer E-Jets and nine Bombardier Q400 turboprops, Flightglobal's Ascend Fleets database records.

The long-haul fleet is set to expand to between 14 and 16 aircraft

as additional intercontinental routes provide "access to growth", says Mikosz.

Introducing further 787s – with potential conversion from the baseline model to the stretched 787-9 – would be the "natural scenario", says LOT's strategy and innovation director Michal Nowak.

But the airline's management is also evaluating the A330neo, and Nowak notes that the -900neo model looks "very promising" for the carrier.

Mikosz rules out any order for the A350, however.

The airline aims to finalise by year-end a narrowbody replacement order for either the 737 Max or A320neo, says Mikosz. That order could comprise 16 to 20 aircraft, says Nowak. LOT is negotiating with both manufacturers but is also considering deals with lessors. ■



The Polish carrier's long-haul fleet is comprised of four 787s

CONTRACT JON HEMMERDINGER WASHINGTON DC

SF Express chooses Precision for 757 conversions

MRO provider Precision Aircraft Solutions has won a contract to convert four Boeing 757-200 passenger aircraft into freighters for Chinese delivery company SF Express.

The deal adds to 10 similar conversions that Precision has done for the Shenzhen-based operator.

It has sourced the four 757s – built between 1995 and 2000 – from lessor AerCap. Until recently they were operated by Thomas Cook Airlines, according to Flightglobal's Ascend Fleets database.

Precision, based in Beaverton, Oregon, holds the supplemental type certificates for the modifica-

tions. It provides the conversion kits, but work is to be performed by three of its partners: Chengdu-based Air China Technics; Haeco in Xiamen; and US firm AeroTurbine. Precision also provides oversight of the projects, sending production managers and engineers to the conversion facilities.

Work will begin on the first aircraft in the coming weeks, with the remainder inducted into the process later this year.

The quartet of 757s will add to SF's existing in-service freighter fleet of 10 757-200Fs, six 737-300Fs and three 737-400Fs, according to Ascend. ■



Documents reveal
Boeing's route to
high 777X output
NEWS FOCUS P14

GROUND HANDLING MICHAEL GUBISCH PARIS

Certification trials to begin with IAI's widebody TaxiBot

Initial tests in France will use trailer before transferring to Frankfurt to utilise 747-400

Israel Aerospace Industries will in December begin certification trials for an in-development widebody version of its TaxiBot pilot-controlled tow-tractor, using a Lufthansa Boeing 747 at Frankfurt.

The tests at the airport will be carried out in partnership with the German airline's technical division, Lufthansa Technik (LHT).

IAI co-operated with LHT's ground services unit LEOS to certificate the original narrowbody version of the semi-robotic tug at the same location in 2014, using a decommissioned 737 from the German carrier.

Earlier this year, the two partners disclosed a tentative deal to jointly conduct the certification trials for the widebody model, but had not revealed a location for the effort.

Lufthansa will in November provide a decommissioned 747-400 from its fleet, with the aim of starting tests in December, IAI programme director Ran Braier told *Flight International* at the Paris air show.

Initial evaluations will begin at



Lufthansa will provide a decommissioned jumbo jet for the effort

Châteauroux airport in France over the coming months using a trailer equipped with an original 747 nose landing gear and its cockpit section, plus ballast to simulate the aircraft's weight.

An aircraft will eventually be required, however, as the trailer's weight can only be increased to around 110t – about a quarter of a 747-8's maximum take-off weight.

When IAI and LHT conducted the narrowbody tug's certification with the 737, trials had to be un-

dertaken at night when the airport was closed to regular flights. The programme was delayed, however, largely due to an unexpected volume and complexity of approval tasks for the pilot-controlled tractor.

Braier says certification of the widebody version should be more straightforward as the team will benefit from experience gained during the previous campaign. It is targeting approval in mid-2016, he says. ■

CONVERSION DAVID KAMINSKI-MORROW PARIS

AEI bags lessor for first 737-800 cargo conversion

US lessor GECAS has become the first customer to sign for Aeronautical Engineers' freighter conversion programme for the Boeing 737-800. Aeronautical Engineers formally launched the programme last year.

GECAS's Cargo Aircraft Group disclosed during the Paris air show that it intends to convert up to 20 of its passenger 737-800s to freighters. Conversion will be undertaken at Aeronautical Engineers' modification centres in China and the USA from next year.

GECAS says it expects the modified aircraft to achieve US Federal Aviation Administration supplemental type certification in 2017 at which point the 737-800SF will be offered for lease as a freighter.

The lessor's executive vice-president for specialty markets, Christopher Damianos, says the company believes the type will be a "best-in-class" aircraft for replacement and expansion in the single-aisle cargo sector.

Cargo Aircraft Group has previously opted to convert 737-300s and -400s to freighters, and its portfolio of cargo jets also includes larger freighter types. ■

PRODUCTION JON HEMMERDINGER PARIS

Stretched suppliers curtail further ATR output rise

Concerns around an overstretched global aerospace supply chain are preventing turboprop manufacturer ATR from immediately raising output to cope with an ever-growing backlog.

"We would love to make new airplanes [faster], but today, with the ramp-up of Airbus, the ramp-up of Boeing and the ramp of Dassault as well, the supply chain is very much under pressure," said chief executive Patrick de Castelbajac, speaking at a Paris air show event.

"We have to wait a bit," he adds. "We are going to stick with the plan."

That envisages a gradual ramp-up to 100 aircraft next year, rising from around 90 in 2015 and 83 in the previous 12 months.

During Le Bourget, ATR disclosed firm orders for 46 aircraft, plus options for another 35.

"There is no shortage of demand," says de Castelbajac. "We are pretty much sold-out."

With re-engining its two in-production types under consideration, de Castelbajac says a replacement powerplant for the current Pratt & Whitney Canada PW127M would have to deliver lower fuel burn and direct maintenance costs, but not an increase

in cruising speed. "My problem is not speed," he says.

That is "not the key driver" due to an ATR operator's typical flight time of less than 1h. "The difference for us, in one hour, would not be massive," he says.

The airframer's performance figures show the ATR 42-600 as having a maximum cruise speed of 300kt (555km/h), while the larger ATR 72-600 is at 275kt. In comparison, Bombardier's rival Q400 cruises at 360kt. ■



Demand for the Franco-Italian turboprop types remains robust

MANUFACTURING STEPHEN TRIMBLE WASHINGTON DC

Documents reveal Boeing's route to high 777X output

Application to state environmental body shows airframer's likely path to achieve record rate for widebody production

Boeing has submitted detailed plans to possibly increase 777X deliveries by 25% to 125 aircraft per year after 2021 using one production line in Everett, Washington, with only minor investments required to reach that target at the final assembly stage.

Its proposal is highlighted in a "technical support document" filed as part of a permit application with a local environmental agency, the Washington State Department of Ecology. Dated last September, it shows that Boeing has divided the 777X production ramp-up into two phases.

The first of these is itself split into two parts, with the initial effort beginning a year ago with the construction of several new production facilities in Everett. That work – highlighted by the creation of a massive new composite wing fabrication and assembly facility – supports Boeing's plan

to begin assembling the first 777X on schedule in 2017.

In the second part of phase one, Boeing plans to ramp up 777X deliveries as output of older models such as the 777-300ER, 777-200LR and 777 Freighter, wind down.

A previously undisclosed second phase of the project could begin as early as 1 December 2021, according to the documents. Boeing's production rate could rise to "as many as 10.4 777Xs per month (about 125 777Xs per year)" during this period, the submission shows.

Despite a roughly 25% increase in output, Boeing's investment in phase two would be relatively modest compared with the initial ramp-up of the 777X to match the current rate of 8.3 per month by 2021.

It would only need to add tooling and equipment to existing and new facilities already erected

to meet the suggested higher rate.

"For example, additional tape layup machines for fabricating wing panels might be installed in the wing component fabrication building, and additional spray booths and a composite press might be installed in the interiors manufacturing building," the documents disclose.

However, they also note that the rate increase to 10.4 aircraft per

month is a "tentative" plan and subject to decisions to be made later by Boeing management.

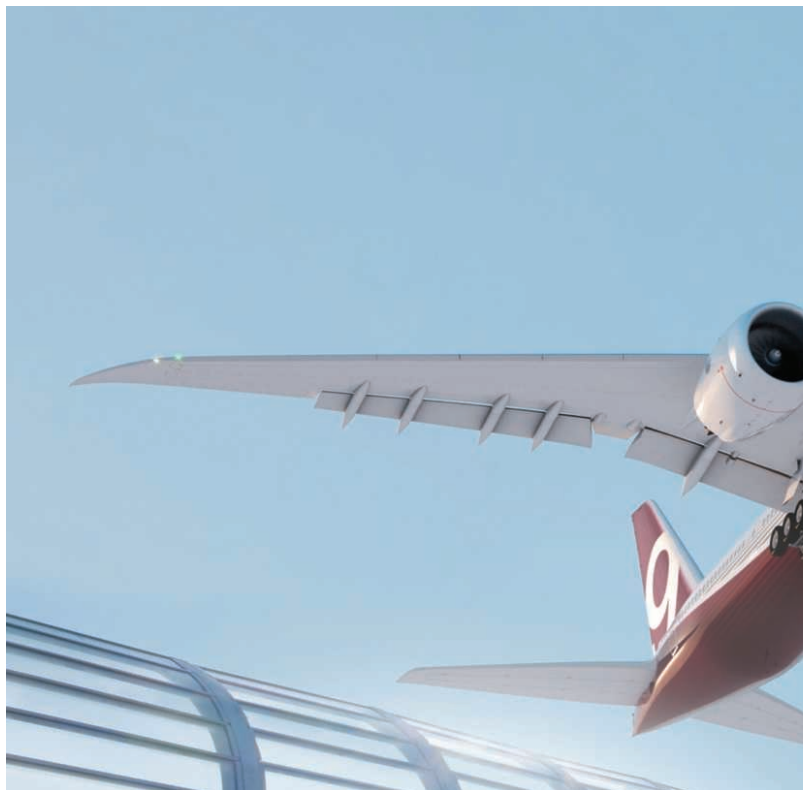
Boeing only confirms that the first 777X is scheduled to begin assembly in 2017 on a low-rate initial production line, which is being erected as part of a new extension of the sprawling wide-body aircraft assembly complex in Everett.

"No future rate decisions beyond the current 777 rate have been made at this point," Boeing adds.

But the company needs to anticipate "any and all future possible requirements", Boeing says. "Part of this evaluation requires Boeing to take action years in advance to ensure environmental permits, tools and parts are complete and ready to support our potential requirements."

FULL CAPACITY

There is more evidence though that Boeing has set an annual output of 125 aircraft as a maximum target for the 777X programme. In 2013, Boeing sent a request for proposals to several US states while searching for alternatives to Everett for basing the composite wing facility and 777X final assembly line. That noted such



Although the current 777-300ER remains popular, Boeing has around 250 unsold slots for the big twin



USAF restores target for F-22 helmet
DEFENCE P16



A single assembly line in Everett could manufacture as many as 125 of the widebody twinjets per year

Boeing

facilities must be able to support a rate of up to 10.4 777X aircraft per month.

If Boeing decides to execute the rate increase, the 777X would take the record for the most productive single widebody assembly line in the world, beating the previous 10-per-month peak rate for the Airbus A330/A340 line in Toulouse, France. Although output on the 787 will rise to a high-point of 14 per month by the end of the decade, that is split between separate lines in Everett and North Charleston, South Carolina.

But a decision to increase production rates comes as several industry forecasts showing that the 777 will struggle to maintain a monthly output of 8.3 per through the transition to the 777X in 2020.

Flightglobal's Ascend consultancy expects that Boeing will be forced to reduce the 777 production rate in 2017 or 2018. As many as 250 open slots remain unsold for the 777-300ER and 777-200LR, says head of consultancy Rob Morris.

Although Boeing expects to preserve the existing rate through the transition, the Flightglobal Fleet Forecast projects that the number of 777 deliveries would

have declined 36% by 2018 and total only 64, representing a monthly output of 5.33 aircraft.

If that projection becomes reality, then increasing the monthly rate to 10.4 would require a doubling of output rather than an increase of 25%, Morris says.

"Perhaps they are simply signaling their supply chain to invest and plan for such higher rates early in the 777X cycle rather than later," he says.

Boeing's latest 20-year market forecast anticipates demand for 3,520 new "medium widebodies" through 2034, a segment the company links to aircraft such as the 777 and Airbus A350-1000. That implies an average of 176 deliveries per year over that time period, leaving ample room for Airbus and Boeing to increase production over the long-term.

In the near-term, Boeing is focused on keeping the 777X development on track. The company plans to enter the detailed design phase later this summer, Boeing vice-president and general manager Scott Fancher told journalists at the Paris air show on 17 June.

So far, the design requirements "have been very stable", Fancher says. That stability has allowed

the company to accelerate development of the aircraft's many internal systems, which should "ensure an even more reliable airplane at entry into service", he says.

Boeing has released two detailed descriptions of the 777-9X over the past nine months that reveal only one exterior configuration change. An airport planning document issued last September initially listed the width of the wheelbase of the main landing gear as 12.8m (41ft 10in), but an update of that posted in May shows the width has narrowed to 10.9m.

WEIGHT AND SEE

The latest version of the "777X Airport Compatibility Brochure" also intriguingly publicly reveals the maximum take-off weights (MTOW) for the 777-9X and 777-8X for the first time. Both 777X variants are listed with a common MTOW of 351,534kg, or 1kg less than the listed MTOW for the 777-300ER. The weight also may have a symbolic meaning, as it converts into an imperial measurement of 777,000lb.

How Boeing achieves a common MTOW with both 777X variants and the 777-300ER is not yet clear. The most recent copy of the airport compatibility brochure does not list any operating empty weights for the 777X types. But the 777-9X fuselage will be longer than the 777-300ER by 2.9m, with a horizontal stabiliser wider by 3m and an unfolded wingspan more

"No future rate decisions beyond the current 777 rate have been made at this point"

BOEING

than 7m greater. The engine pylons, meanwhile, are moved 1m outboard on the 777-9X compared with the 777-300ER.

Although the requirements have remained stable, Boeing has made several tweaks to the 777-9X design since the programme was launched in late 2013. For example, the airframer has removed the hybrid laminar flow control system from the vertical fin of the 777X. The system was invented for the 787-9 and 787-10 to cut drag by up to 1%. But the system was deleted from the 777-9X configuration because the aircraft did not need the performance boost, Boeing says.

Although GE Aviation has confirmed that the GE9X fan diameter has widened slightly to 340cm (134in), Boeing's Fancher says the diameter and the 105,000lb-thrust (467kN) power level have been unchanged in the last two years.

"The baseline engine was set two years ago, I think, and hasn't changed since," Fancher says. "Early in the design we saw some iteration. But the basic engine fan diameter hasn't changed in a couple years. The thrust hasn't changed in quite a while." ■



Boeing

Latest brochures reveal the MTOW of both 777X variants at 352t



UPGRADE JAMES DREW WASHINGTON DC

USAF restores target for F-22 helmet

Delayed project to give Raptor pilots ability to visually cue air-to-air weapons set to deliver operational system by 2020

A long-running effort to provide pilots of the Lockheed Martin F-22 with a day and night helmet-mounted display (HMD) and cueing system has taken a significant step forward, with the US Air Force publishing a draft programme schedule and requirements list that would deliver an operational system by 2020.

The HMD will allow a pilot to visually control sensors and weapons at high off-boresight angles, particularly Raytheon's AIM-9X Block II air-to-air missile.

Such a capability has been a validated requirement of the F-22 programme since 2007, but cost pressures and sequestration cuts have repeatedly seen the acquisition pushed back. Most recently, a planned demonstration of the Visionix-Gentex Scorpion helmet-mounting cueing system was terminated in 2013.



US Air Force

Acquisition of the HMD technology has been repeatedly put back

According to a draft requirements document dated 1 June, the F-22 programme office wants a mature helmet system that would be ready to enter a four-year development and test period starting in 2017. Laboratory and simulator testing would take

place in 2018, ahead of flight trials in 2019.

The USAF says it will accept an assembly that uses the existing Gentex HGU-55/P helmet – either modified or in its current form – or a new design. The programme will not accept a reduced field of

view, or any degradation in performance across the Raptor's flight envelope, including high-g manoeuvres, crash, ejection, bailout or water entry.

Key requirements include the day and night cueing of weapons and sensors at high off-boresight angles, as well as the ability to process and display data and video feeds from those devices.

The helmet "will also be able to receive and display target, weapon and flight data for aircraft state, navigation and air-to-air/air-to-ground weapon delivery while maintaining visual contact with the target," the document says.

The AIM-9X Block II and Raytheon AIM-120D AMRAAM medium-range air-to-air missile will be fully available on the F-22 by 2017, as part of the type's Increment 3.2B upgrade. ■

FLEET GREG WALDRON PARIS

Korean FA-50s near clearance

Korea Aerospace Industries' (KAI) FA-50 light fighter should obtain final operational clearance with the South Korean air force in late 2016, says Sang Choi, vice-president and general manager in the company's international marketing department.

The Republic of Korea Air Force already has one operational squadron of 20 FA-50s, and a second unit should be set up by the end of this year, Choi said at the Paris air show.

KAI has never disclosed the size of the South Korean FA-50 order, but Seoul will probably end up taking about 60-100 examples to replace its Northrop F-5s.

Meanwhile, Choi says deliveries of 12 FA-50s to the Philippines will commence late this year, under a deal signed in 2014. Iraq, which has ordered 24 locally-designated T-50IQ examples, will get its first dozen in 2016. ■

DEVELOPMENT CRAIG HOYLE PARIS

August goals set for TAI programmes

Turkish Aerospace Industries (TAI) is preparing for a series of spin-recovery test flights using one of its prototype Hurkus turbo-prop-powered trainers.

Seven or eight flights will be conducted from August with a recovery parachute installed, says Özcan Ertem, head of the company's aircraft group. TAI opted against exhibiting the type at the Paris air show due to this schedule, but gave static display debuts to its Anka unmanned air vehicle and T129B attack helicopter in Le Bourget.

Verification flights with the Hurkus will be performed for the European Aviation Safety Agency in October ahead of the expected receipt of certification early next year, Ertem says.

Fifteen of the type will be delivered to the Turkish air force, running from June 2018 to late the following year, while the service could potentially add a



Turkish Aerospace Industries

Hurkus trainer deliveries should commence in 2018

further 40 to this total. The additional aircraft would support a proposed international training centre at Izmir air base, also equipped with upgraded Northrop T-38 jet trainers.

Meanwhile, the Turkish government has invited five companies to express interest in partnering with TAI on Turkey's indigenous TFX fighter programme, with responses due in August. Airbus Defence & Space,

Alenia Aermacchi, BAE Systems and Saab have been approached to participate in the process, along with China's CATIC.

A request for proposals has also been issued for the production of prototype aircraft in support of the TFX effort, which assessed one twin-engined configuration and two single-engined designs during its concept phase, which concluded in 2013. ■



Patroller gets ready
for domestic test
DEFENCE P19

PROTOTYPE

Honeywell set to power India's HTT-40 trainer

Hindustan Aeronautics' (HAL) HTT-40 trainer prototype will be powered by Honeywell's TPE331-12B turboprop engine.

The Indian defence ministry intends to buy 68 examples of the locally-developed trainer as part of its 180-aircraft requirement to replace the already-retired HAL-built HPT-32 Deepak. The remainder of the need will be satisfied with Pilatus PC-7 Mk IIs.

Once developed and delivered, the HTT-40 will be used for basic pilot training at the Indian air force academy.

"HAL's new HTT-40 will offer pilots rapid acceleration, improved reliability and the ability to train for a wide range of missions," says Honeywell Aerospace India president Arijit Ghosh.

Honeywell has built upwards of 13,000 TPE331 engines for both military and civilian types. ■

MILESTONE BETH STEVENSON LONDON

Testing of F-35B to ramp up following ski-jump take-off

Successful launch signals start of integration of Lightning II with UK's future aircraft carriers

BAE Systems test pilot Peter Wilson has made the first short take-off of a Lockheed Martin F-35B using a "ski-jump" ramp installed at NAS Patuxent River in Maryland.

Test aircraft BF-04's launch on 19 June marked the start of the first phase of testing to support the F-35B's integration aboard the UK Royal Navy's future pair of Queen Elizabeth-class aircraft carriers. The work is being conducted by a US/UK integrated test force.

The HMS *Queen Elizabeth* and HMS *Prince of Wales* each have an upward-sloping ramp at the bow, which will enable the F-35B to take off at an increased weight and slower speed than a horizontal launch would permit, the UK Ministry of Defence says.



The ramp allows take-off at a lower speed than a horizontal launch

The milestone came one week after another UK test pilot released two inert Raytheon Systems Paveway IV precision-guided bombs from an internal

weapons bay using test aircraft BF-03. The 226kg (500lb) weapons were dropped over the Atlantic Test Ranges near the Patuxent River site. ■

TESTING BETH STEVENSON PARIS

Adapted Fokker 100 to nose Falcon out of test role

France's DGA defence procurement agency will receive its Fokker 100 by the end of 2015, following the completion of modifications to allow the twinjet to conduct systems testing for the Dassault Rafale.

Displayed for the first time during the Paris air show, the aircraft is planned for delivery to the DGA's CEV flight-test unit at Cazaux air base at the end of the year, with flight testing to commence at the beginning of 2016.

"When these systems are being developed they can work on the ground, but when installed on an aircraft you can start to see problems," Claude Chenuil, director of flight-testing at the DGA, tells *Flight International*.

The adapted Fokker 100 is intended to replace the Dassault Falcon 20, seven of which are currently operational with the CEV from what was once a 14-strong fleet. A further four are

expected to be retired once the larger type begins operations.

The Fokker 100 allows multiple systems to be integrated for simultaneous testing, and its "plug-and-play" modification means racks of electronics can be rolled on and off as required.

"It [the Falcon] was dedicated to a single system, but because the Fokker is larger the plan is to carry out different tests at the same time," Chenuil says.

Around 50 flights per year are currently carried out using the Falcon fleet, but the aim is to increase flights to 150 once Fokker operations begin, with the new type to "replace 90% of the Falcon 20" activities. However, the remaining Falcons will be used for the foreseeable future, because the type can carry out stall testing.

In all, 80% of the systems testing for the Rafale will be performed using the Fokker 100,

with additional work employing an adapted Dassault Mirage 2000.

Chenuil says there are still years of operational life left in the Fokker 100, which Flightglobal's Ascend Fleets database records as having been built in 1990, with some 35,000 flying hours accumulated.

Since being acquired for the DGA in 2013, the aircraft has been modified by Sabena Technics, and is equipped with a Rafale nose section housing the fighter's Thales RBE-2 active electronically scanned array radar and front sector optoelectronic equipment. It was exhibited at the show with a Thales Reco NG targeting pod beneath its fuselage and MBDA Mica air-to-air missiles to support seeker testing.

The modification specialist is in the final stages of making the aircraft compliant with its European Aviation Safety Agency certification, Chenuil says. ■



France's DGA gave the testbed a debut showing at Le Bourget

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Gulfstream pair are better connected
BUSINESS AVIATION P20

UNMANNED SYSTEMS BETH STEVENSON PARIS

Patroller gets ready for domestic test

UAV's multi-intelligence capability makes it the right choice for French military's SDT requirement, Sagem official claims

Sagem is hoping that the first customer for its Patroller unmanned air vehicle will be its domestic military, after its predecessor system – the Sperwer – was exported several times before it was acquired by the French army.

Patroller is being pitched to France for its Système de drone tactique (SDT) programme, for which three contenders are undergoing or planning flight demonstrations of their systems in the coming weeks.

The other offerings are the Thales WK450 Watchkeeper and Airbus Defence & Space/Textron Systems Shadow M2.

“For Sperwer, France was the fourth customer,” says Frédéric Mazzanti, vice-president of Sagem’s optonics and defence



Flight demonstrations with the type will be performed during July

division. “We hope that this time the French will be the first. We have a very strong team for this.”

Sagem is working with Ecarys/Stemme, which provides the

aircraft, while Selex ES provides its imaging radar and avionics equipment. The Patroller also carries the Euroflir 410 optonics system developed by Sagem.

Mazzanti claims that the Patroller has a competitive edge because of its multi-intelligence capability, as well as its ability to transmit multiple types of sensor information simultaneously.

“We are able – and will demonstrate this in July to the French army – to broadcast all the data to the ground at the same time,” Mazzanti said during the Paris air show. Tests of the SDT candidate will take place at Istres air base, he adds.

Depending on the configuration required, between eight and 11 sensors can be incorporated into one gimbal on Patroller, which, Sagem says, also benefits from a wide-range radar and narrow forward-looking infrared sensor. ■

CAPABILITY GREG WALDRON SINGAPORE

Australian boom success will help Wedgetail soar

The Royal Australian Air Force (RAAF) has conducted trial refuellings of a Boeing E-7A Wedgetail airborne early warning and control system aircraft using one of its Airbus A330 multirole tanker transports.

Performed off the coast of New South Wales from 1 to 13 June, the work advances the service’s locally-designated KC-30A fleet towards achieving full operational capability. Some 118 “dry” contacts were made with the type’s advanced refuelling boom system, before 20t of fuel was transferred in a further six contacts, the Department of Defence says.

“Once the trial results are assessed, an initial clearance

is expected to be granted to allow Wedgetail crews to begin refuelling training flights with the KC-30A,” says Wg Cdr Christian Martin, commanding

officer of the RAAF’s E-7A-equipped 2 Sqn.

Australia’s KC-30As have been cleared to use their underwing hose-and-drogue refuelling pods



A KC-30A tanker delivered 20t of fuel to an E-7A during flight trials

since early 2013, when the type obtained initial operational capability status. But availability of the boom has been the subject of significant delays, after its first of five aircraft suffered “some limited damage” during a testing mishap in January 2011.

A Portuguese air force Lockheed Martin F-16 also received minor damage when part of the boom broke off.

By 2023, only 36 RAAF aircraft will still use hose-and-drogue refuelling: its current 24 Boeing F/A-18F Super Hornets and 12 on-order EA-18G Growlers. The remaining 100 aircraft in its future fleet, including Lockheed F-35s, will rely on a boom. ■

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UPGRADE

Gulfstream pair are better connected

US regulator approves installation of Satcom Direct equipment on G450 and G550, simplifying in-flight communications

Gulfstream has received US Federal Aviation Administration approval for a modification that allows operators of some 825 G450 and G550 business jets to benefit from enhanced connectivity.

Covering the installation of a Satcom Direct router (SDR), the enhancement simplifies cabin communications on the two large-cabin twinjets.

"This equipment elevates the airborne office to a new level," says Mike West, vice-president, product support sales and new business development, Gulfstream. "The addition of a smart router allows for more communications options in the cabin, including Satcom Direct's GlobalVT, which allows passengers to use their personal smartphones to call and text in flight."

The SDR also supports mobile applications for onboard cabin services, including moving map and flight tracker, command and control of satellite links, and real-

time connection status reporting.

The SDR interfaces with Via-Sat's Ku-band and Inmarsat's SwiftBroadband systems, and is designed to work with future connectivity offerings, including those operating on the Ka-band.

Installation of the SDR and accompanying software is standard on new G550 and G450s and available as a retrofit for in-service examples.

The new equipment, which weighs less than 4.5kg (10lb), is designed to be installed inside the cabin or avionics bay.

Gulfstream is pursuing similar supplemental type certificates from the FAA to add the enhancement to its ultra-long-range G650/G650ER and out-of-production GV and GIV business jets.

Meanwhile, the US airframer says its first G600 prototype is taking shape at its Savannah, Georgia headquarters and first flight of the large-cabin, long-range business jet remains on target for next year.



First flight of the all-new G600 is anticipated early next year

The \$54.5 million clean-sheet G600 was launched last October alongside its shorter-range stablemate, the G500. The \$43.5 million G500 is being developed first. Its flight-test campaign is already underway and certification and service entry are planned for 2018. Deliveries of the G600 will follow between 12 to 18 months later. "The first aircraft is being assem-

bled and we hope to have it flying in 2016," says Gulfstream senior vice-president, worldwide sales and marketing, Scott Neal. Certification and service entry are expected in 2019.

Gulfstream will not disclose how many orders it has received for both types, but Neal says the response to its newest models has been "overwhelming". ■

CONTRACT

France renews Daher support

The French defence ministry has renewed a multi-year contract with Daher for the continued operational support of its TBM 700 fleet. The deal was awarded by the French military procurement agency's SIMMAD maintenance organisation following an 18-month tender process. It covers the airframe, engine and propeller on all 27 of the military's high-speed, single-engined turboprops.

The aircraft are used by the French armed forces for VIP transportation and training. The inventory consists of 15 TBM 700As used by the French air force; five 700As and eight TBM 700Bs deployed by the French army aviation; and four 700As assigned to France's flight test centre.

The initial contract was awarded to the Tarbes-based company in



The deal covers 27 TBM 700s

2001, shortly after the creation of SIMMAD. It was renewed in 2007 and again in 2011 when the aircraft were upgraded with the Garmin G1000 integrated flightdeck.

The agreement also includes continued airworthiness monitoring of the fleet – located at seven different air bases – along with logistics support for aircraft on detachment in Europe, Africa and the Middle East. ■

PROGRAMME STEPHEN TRIMBLE PARIS

Plummeting ruble revives prospects for VIP Tupolev

If there is a silver lining to Russia's current economic woes, then perhaps it is the revival of interest in a VIP version of the Tupolev Tu-204.

United Aircraft (UAC) chief executive Yuri Slyusar says he believes the VIP version of the long-range twin-jet is more competitive now, thanks to his country's troubles.

"With the recent economic changes, we think there is a case for a business jet version"

YURI SLYUSAR
Chief executive, United Aircraft

"With the recent economic changes – the weakening of the ruble – we think there is a case for a business jet version of this aircraft because it's a modern aircraft for 38 passengers with a range of 9,600km [5,180nm] which will sell for about \$50 million," he says.

UAC's commercial focus is on ramping up production of the Sukhoi Superjet and completing development of the Irkut MC-21, but Tu-204 production continues.

Its business plan calls for building six to eight Tu-204s annually for a mix of commercial, special mission and VIP customers.

In 2010, Russia's Interstate Aviation Committee granted approval for a VIP variant of the aircraft designated the Tu-204-300. ■



MoM into momentum
– the case for the
middle market
ANALYSIS P22

SHARED OWNERSHIP KATE SARSFIELD LONDON

Flexjet fractional fleet gains G450LXis

US fractional ownership company Flexjet has taken delivery of its first two Gulfstream G450s from an October 2014 order for up to 50 of the airframer's large-cabin and ultra-long-range business jet family. The deal includes a firm order for 10 G450s, six G650s and six G500s.

The aircraft will carry the LXi suffix to reflect the customised interior, which is exclusive to all the new models in the Flexjet fleet.

The Directional Aviation Capital (DAC) subsidiary is the only fractional provider adding new Gulfstream types to its operation. It will also be the only company within this niche to offer the top-of-the-range G650 and the in-development G500 when the duo are added to the Flexjet line-up in 2016 and 2018 respectively.

Rival NetJets is phasing out its 75-strong Gulfstream inventory. This is being replaced with Bombardier's Global 5000/6000/7000, 8000 family.

"When we placed this order with Gulfstream, we wanted to make sure we would be able to offer these new aircraft to our owners in a timely manner," says



The new model is fitted with the operator's customised interior

Flexjet chairman and DAC principal Kenn Ricci. "The delivery commences a period in which we will be the only fractional provider adding new Gulfstream aircraft to our fleet, making them available on an exclusive basis."

The G450LXi can travel 4,350nm (8,050km) with eight passengers, "easily allowing for non-stop trips from the USA to European and South American destinations," says Flexjet. The 7,000nm G650LXi can travel non-stop from the USA to Europe or Asia, it adds.

Michael Silvestro, chief execu-

tive of the 20-year-old company, says the new aircraft are joining the fleet as demand for fractional ownership is on the rise. "Our fractional flying activity in the first quarter of 2015 was up 10% over 2014," he says, "and we expect this growth to continue [as we introduce these new aircraft]." Fractional sales in the first quarter climbed by 70% compared with the same period in 2014.

Flexjet has more than 200 business jets on order, including aircraft from the Bombardier and Embraer ranges. ■

TRAINING
KATE SARSFIELD LONDON

Phenom 100E deal for Etihad Flight College

Embraer has sold seven Phenom 100Es to Abu Dhabi's Etihad Flight College. The deal for four firm orders and three options is valued at around \$30 million and the first of the entry-level jets will be handed over to the Etihad Airways subsidiary in the first quarter of 2016.

The Phenoms will be the first jet aircraft in the college's training fleet, which currently consists of 16 piston aircraft types – 10 Cessna 172SP Skyhawk singles and six twin-engined Diamond DA42s.

Based in Al Ain, the former Horizon International Flight Academy provides training for up to 120 cadets annually. ■

SUPPORT
KATE SARSFIELD LONDON

Pilatus expands PC-12 service centre network

Pilatus Aircraft has added a 60th PC-12 authorised service centre to its global network. Santiago-based business aviation services provider Aerocardal will maintain and support the single-engined turboprop within Chile and surrounding Latin American countries, where the Swiss airframer has a small but expanding fleet.

According to Flightglobal's Ascend Fleets database, there are 69 PC-12s in service across the region, out of a worldwide fleet of more than 1,300 aircraft. ■



Santiago-based Aerocardal is to support the turboprop type

VIP AIRLINER KATE SARSFIELD PARIS

Alpha Star is first customer to order Airbus ACJ319neo

Saudi Arabian services provider plans to take delivery of re-engined narrowbody in 2019

Airbus has identified Saudi Arabian business aviation services provider Alpha Star as the first customer to commit to the ACJ319neo corporate airliner.

The Riyadh-based company has yet to select the powerplant on completion centre, but Airbus says delivery of the VIP airliner should be in the second quarter of 2019.

The ACJ319neo was launched in May along with its larger sibling, the ACJ320neo, whose launch customer is Farnborough, UK-based Acropolis Aviation.

The duo are VIP versions of the re-engined A320neo family, the first of which is scheduled to enter airline service later this year. The Neo types feature more efficient engines – a choice between the CFM International Leap-1A or Pratt & Whitney's PW1100G – and wing-tip-mounted sharklets, leading to improvements in fuel burn, range and performance. They also have more comfortable and technology-enhanced cabins. The ACJ320neo will be capable of carrying 25 passengers 6,000nm

(11,100km), while the ACJ319neo will take eight passengers 6,760nm.

Alpha Star chief executive Salem Al Muzaini says that "improved versions" of the Airbus single-aisle line are a "natural next step" for investment.

The operator owns a fleet of Airbus corporate jets, comprising ACJ318s, ACJ319s, ACJ320s, an ACJ330 and an ACJ340. It also operates traditional business jets, including the Hawker 900XP and Gulfstream G550. ■



OUTLOOK RICHARD EVANS LONDON

MoM into momentum – the case for the middle market

Will developing a new 180-250-seat airliner make economic sense for Boeing and Airbus?

One of the major subjects of discussion over the past two or three years has been the need for what is often called a Boeing 757 replacement aircraft to fill the Middle of the Market (MoM) gap.

MoM is hard to define, but is at the cross-over point between single- and twin-aisle aircraft, between 180 and 250 seats. Air Lease Corporation's Steven Udvar-Hazy has been very vocal in calling for such an aircraft, and ALC has placed a launch order for the new Airbus A321neo LR – the closest current or new type that fits the bill in terms of seats and range capability.

It is clear Boeing is thinking about a MoM aircraft concept carrying around 220-240 people about 20% farther than the 757-200, which implies around 5,000nm (9,260km) nominal range, and that the aircraft would be a twin-aisle design.

This places the aircraft in a currently vacant piece of the payload/range envelope, but not necessari-

ly in one that has not been served before. Flightglobal Ascend believes this is really a 767 replacement, not a 757 replacement.

The other key design aim is obviously to offer attractive operating economics, including the acquisition cost. This is a major challenge to Airbus and Boeing, with Boeing in particular having a hurdle to jump after huge cost over-runs on 787 development.

STRUCTURE

The reference point in terms of cost per seat will be the A321neo, and single-aisle aircraft have an advantage from the start in terms of operating costs due to their lighter structure.

In fact the current A321 and 737-900 match the cash operating cost per seat of the much larger 787 in comparable dual class layouts. The 737 Max and A321neo offer a 5% reduction in cost per seat so become the aircraft of choice for routes up to around 3,500nm – unless belly cargo is

important, or airport congestion is an issue.

The costs of developing a new programme do not necessarily scale down with a smaller aircraft, so an all-new 220-240 seater would likely cost almost as much as a larger widebody programme. Therefore the size of the potential market becomes a key factor in deciding whether to proceed with a new launch.

If only 1,000 aircraft were sold, a \$20 billion investment would need \$20 million per aircraft extra on the price just to pay back the development costs, compared with an A321 full-life base value (FLBV) of around \$54 million.

Aircraft prices are usually related in some way to payload/range capability. If the current A321 were taken as the reference, then the MoM aircraft would have a net price tag around 40% higher (20% more payload plus 20% more range), coming in at \$75 million.

If instead we work down from the 787-8, which has an FLBV of \$118 million, the figure is similar, so this gives a good guide as to the potential net price. So an all-new aircraft probably requires a market of 3,000-4,000 units in order to be attractive. In the 9-15 June issue of *Flight International* we addressed the technical challenges of a potential new offering, and here we will concentrate on the potential market.

The market gap will look different from the perspective of Airbus or Boeing. However, the size and range capability conclusions are probably similar. This means the aircraft is actually close to the original 767-200 (non-ER) or A310-300. Presumably a manufacturer would seek to offer a family of aircraft, implying a stretch aircraft would be similar in capability to the 767-300 or A300-600.

It is not very instructive to analyse the customers or route networks of these types, as 30 years



have passed since they entered service. Many aircraft were used on US domestic routes, or intra-European services, which have since moved to single-aisles as the range capability of those types has increased. We can look at the growth in capacity by distance over the past decade.

Flightglobal's Innovata schedules database shows that there has been slower growth in the 3,000-5,000nm band. Available

A new 220-240 seater would cost almost as much as a larger widebody programme, so the potential market is a key factor

seat kilometres have only increased by 3.8% per annum, compared with 5-6% per annum in the single-aisle dominated 1,500-3,000nm band.

Although overall growth has been unspectacular, the 3,000-5,000nm range band is important to several major markets, and contains the core networks of some of the fastest growing carriers. It covers most of the Transatlantic market, routes from Asia to Australasia, southeast Asia to northeast Asia, and routes from the three Gulf hubs to much of



ALC's Steven Udvar-Hazy has called for a middle market aircraft



Going with the flow
COVER STORY P24



Boeing ceased production of the 757 in 2004, since when there has been much discussion of its potential replacement

Rex Features

Europe and Asia. Turkish Airlines and Aeroflot have both seen huge growth in this range band.

This means this range bracket is key to five of the fastest growing large network airlines.

It might be difficult to imagine airlines such as Emirates moving away from large aircraft, or a 240-seat aircraft replacing 777s and A380s on London to Los Angeles, but there are many city pairs that offer opportunities to increase frequency, plus numerous new pairings that could be flown.

Today the 787 or A330-200 are the obvious types to launch new routes above 3,000nm, but the trip costs are around 50% higher than a 737-900 or A321.

POTENTIAL

In 2014, there were 675 single aisle routes of over 2,500nm "great circle" distance being flown on a scheduled basis. Of these, a staggering 642 were not flown by single-aisles in 2005. Most are completely new routes.

Some airlines are already pushing single-aisles to their range limits and will presumably go further with Max and Neo. One of these is Turkish Airlines, but US majors and Panama's Copa are also launching new routes with single aisles. Copa and Turkish are now two of the three biggest users of long-range single-aisles, and neither have ever operated the 757.

It appears there is a substantial potential market for an aircraft with greater range than today's single aisles and comparable costs per seat. But the big question is: why should Airbus or Boeing do anything in this market? They both have twin-aisle products that can address the range, and will share the single aisle market roughly 50/50 for the foreseeable future.

One theory is that the superior payload range of the A321neo will put pressure on Boeing to move first. The A321neo has seen far more orders to date than the 737 Max 9, outselling it by four to one, but there have only been a couple of turnovers of traditional Boeing operators, namely Lion Air and Pegasus. Boeing has won Air Canada from Airbus.

However, of the 20 airlines with the most MoM capacity in 2014, Airbus has already won A321neo orders at British Airways and Iberia, Lufthansa, American and US Airways, Turkish, Qatar and Etihad.

BATTLEGROUND

Boeing has won 737 Max 9 commitments from United, Turkish and Air Canada. Perhaps the key battleground will be at Delta, which is a major 737-900ER customer, but has also recently ordered A321neos.

Alternatively, if the A330neo is a comparative failure against the 787, Airbus may move first.

It is too early to say if either of these scenarios will force a move. But both companies have huge en-

gineering teams that will need programmes to keep them busy after 2020. Boeing in particular has an issue with engineers retiring over the next few years, so may feel a need to strike first. However, a multi-billion dollar programme seems unlikely unless market share erosion forces it.

The business case probably needs at least 2,000 aircraft and the market may only be large enough for one player. The first mover would need to assume that a large chunk of the business is incremental, not simply diverted away from an existing platform. ■

Richard Evans is a senior consultant with Flightglobal's Ascend advisory service. To download this opinion piece in full go to flightglobal.com/paris



Airbus

The A321neo has been ordered by airlines including British Airways, Lufthansa, American and Etihad

GOING WITH THE FLOW

Boeing's latest ecoDemonstrator testbed is a retiring 757 on which it will research bug-phobic coatings and new recycling methods in a bid to speed green applications

KERRY REALS LONDON

Boosting aerodynamic efficiency is the cornerstone of Boeing's latest battery of ecoDemonstrator test flights. The tests are being carried out on a near-end-of-life 757 that will later be used to test new aircraft-recycling techniques, before being consigned to history.

The 757 is the third aircraft type to undergo ecoDemonstrator test flights, following earlier programmes involving a 737-800 in 2012 and a 787 in 2014. While the 737 flights were carried out in conjunction with American Airlines, and the 787 flights were run under the US Federal Aviation Administration's continuous lower energy, emissions and noise (CLEEN) programme, Boeing has chosen a European airline partner – TUI Travel – to work with on the 757 tests.

The overall aim of the ecoDemonstrator programme, says Boeing Commercial Airplanes director of environmental performance Jeanne Yu, is to speed up the implementation of fuel-saving technologies in aviation, and

“inspire people to action” on developing more environmentally-friendly aircraft.

Whereas the 737 ecoDemonstrator focused strongly on adaptive wing and regenerative fuel cell technologies, and the subsequent 787 programme concentrated on ceramic matrix composite nozzle design, the latest round of testing will look at ways of reducing environmental effects on natural laminar flow. A key piece of this research involves the application of various insect-repelling, or “bug-phobic”, coatings to the leading edge of the aircraft's left wing to try to reduce drag by minimising the amount of insect residue.

DE-BUGGING TECHNOLOGY

“Any bug you have on an airplane will affect drag,” says Yu, adding that a total of five different “microscopically adhered” coatings will be tested. The bug-phobic testing is being carried out in conjunction with NASA's environmentally responsible aviation (ERA) project. Sections of the various coatings will be applied to the leading edge slats, after establishing a baseline by using uncoated surfaces to capture insect-accumulation levels. Durability of the coatings will be examined to see how they withstand flight conditions.

The coatings will be tested on 15 separate flights, taking place throughout June and coming to an end in July. These tests will be carried out in Shreveport, Louisiana, a location chosen because of its high insect levels. Shreveport was selected from 90 candidate airports on account of its “runway length, temperature, humidity, weather, ability to handle a 757 aircraft and thunderstorm frequency”, says NASA. Knowledge gained by NASA – with the exception of anything that uses Boeing's proprietary technology – will later be made publicly available to benefit the entire industry.

Another set of 757 ecoDemonstrator tests, completed in April, focused on active flow control. These tests involved installing 31 actuators to force jets of air on to the aircraft's vertical tail and rudder surfaces, the aim being to reduce the size and weight of the tail that is needed by

Boeing chose European TUI Travel as its partner to work on 757 tests



“Shaving aircraft fuel consumption by even a few points can save millions”

FAY COLLIER

Project manager, ERA

generating the same side force during take-off and landing that a larger tail provides.

The results of the nine test flights carried out in Seattle are now being analysed. However, NASA expects them to confirm the findings of an earlier wind tunnel test, which showed that the active flow control jets could increase side force by 20-30%. “A 20% increase in side force could allow designers to scale down the vertical tail by about 17% and reduce fuel usage by as much as 0.5%,” says NASA.

“Solutions to reduce fuel use by 1% or 2% may not sound like much,” says Fay Collier,



Tests are aimed at reducing tail size and weight



manager of NASA's ERA project. "But shaving aircraft fuel consumption by even a few percentage points can save millions of dollars and help protect the environment from harmful emissions."

The two NASA experiments on board the 757 ecoDemonstrator form part of eight ERA technology demonstrations that are being conducted this year and will bring the project to a close. The eight demonstrations span five focus areas: aircraft drag reduction; weight reduction through use of advanced composites; fuel and noise reduction through advanced engines; emissions reductions through improved engine combustors; and fuel and noise reduction through aircraft configuration changes. With all eight of its demonstrations, NASA aims to mature the technologies to the point where there would be less risk for aircraft manufacturers to incorporate them into future designs.

"Having a relevant testbed, such as Boeing's ecoDemonstrator, to help mature technology concepts is extremely important to NASA's environmentally responsible aviation project," says Collier. "Our researchers have been working hard to develop technologies to reduce airplane fuel consumption, noise and emissions. Being able to prove those concepts in flight tests gives them a better shot of getting into the commercial fleet."

ACCELERATING CHANGE

A total of 15 different technologies will be tested as part of the 757 ecoDemonstrator programme, compared with 32 technologies on the 787 platform and 12 on the 737. Some of the previously tested technologies have already been – or soon will be – put into practice, says Yu. These include an "advanced technology winglet" concept that was tested on the 737 ecoDemonstrator and was later "transitioned

right into the baseline design for the 737 Max". The new winglet can improve fuel efficiency by as much as 1.8%, says Boeing.

In addition, a new lightweight material that was installed under the aft wing section of the 787 ecoDemonstrator aircraft "will be wrapped into production" of future 787s, says Yu. "We plan to see this flying on the 787 in the next year," she adds.

"A lot of the technologies will be seen on multiple airplanes, with some near-term and some longer-term timelines," says Yu. "Transitions will happen at different times. For example, we probably won't see fuel cells for another 15 years. The main thing is to speed up implementation."

Boeing deliberately chose a 757 that was nearing the end of its commercial life to be its latest ecoDemonstrator testbed because, once flight tests are over, the airframer plans to work with the Aircraft Fleet Recycling Association

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Cengiz Turkoglu
Senior Lecturer, **City University**



Sir Timo Anderson
Consultant Principal
Charlesworth Associates Ltd



Jorge Leite, VP Quality and Safety – M&E Safety Manager
TAP Maintenance & Engineering



John DeGiovanni
Managing Director – Safety
United Airlines



Robert Jan de Boer
Professor of Aviation Engineering
Amsterdam University of Applied Sciences



Captain Tilmann Gabriel
Global Aviation Expert, **City University**



Stephen Hoy
Operations Quality Manager, **Nordam**



Chris Parsons
Lead Air Safety Consultant, **Atkins**



Brett Dale-Heaps
Managing Director, **Blue Altitude**

 Flightglobal

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VP Quality and Safety - M&E Safety Manager
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John DeGiovanni
Managing Director - Safety
United Airlines
Carlton Van Houten
Operations Safety Manager, **Fligh**

Mike Anderson
Senior Director of Safety
Safe Airways
Rob Zeman
Head of Safety & Compliance
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Paul Carlin
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Flight Safety
Symposium

» (AFRA) to look at new recycling methods. “We’re hoping that in parting it out we will learn more about how to recycle,” says Yu.

In mid-2010 AFRA set an ambitious target for 90% of the materials from scrapped aircraft to be recycled – preferably into products in the aviation supply chain – by 2016.

Boeing has already made some headway on finding new uses for scrapped carbonfibre, an example of which could be seen on the 787

ecoDemonstrator aircraft. Small access doors on the underside of the ecoDemonstrator’s wings were manufactured using excess carbonfibre from the production of trailing edges for the 787 at Boeing Aerostructures Australia. Boeing says this was the first time that recycled carbonfibre from aerospace parts had been recycled for commercial aircraft use. “We’re trying to find new uses for carbonfibre and we continue to look at that,” says Yu.

Once the latest round of ecoDemonstrator test flights comes to an end in July, Boeing and its partners will analyse the results to try to work out which technologies can be transitioned to commercial-use platforms, and when. Yu says the airframer is “not talking about” any other possible future ecoDemonstrator programmes at this stage, but “will likely start doing smaller demos and ground demos” in the meantime “to fill in the gap”. ■

RESEARCH STEPHEN TRIMBLE PARIS

BOEING MULLS FRESH PROTOTYPE AIRCRAFT FOR FUTURE ECODEMONSTRATORS

FIVE AIRCRAFT demonstrator programmes launched by Boeing’s commercial division since 2001 all share a defining characteristic: an ordinary aircraft modified or stuffed with brand-new technologies.

Leveraging aircraft already in production as the demonstrator platform has allowed Boeing’s product development organisation to focus on testing dozens of potential new technologies. But that policy also limits Boeing’s experiments to the classic “tube-and-wing” configuration, rather than possibly more fuel-saving alternative designs.

As Boeing begins to plan for a future round of ecoDemonstrator testing, company officials will consider breaking from the traditional platform to designing, building and flying a new prototype featuring an unconventional approach to integrating the airframe and propulsion system.

“If we’re going to be planning [ecoDemonstrators] every year, every two years – and if I want to start thinking today about a 2020 ecoDemonstrator – I’m not limited then to the paradigm of using an existing production airplane,” Boeing



The truss-braced wing is an alternative considered by Boeing

vice-president of product development Mike Sinnett says.

“You could imagine one of many partners that could help us build a prototype airplane at a cost structure that, even if it was subscale, could demonstrate some of those other configurations,” he adds.

ALTERNATIVE DESIGNS

The classic jet-powered airliner configuration – an oval or circular fuselage with podded engines tucked under a low-slung wing – has stayed remarkably stable, despite nearly six decades of incremental design improvements. As aircraft designers look two or three decades into

the future, however, different configurations are becoming attractive.

Boeing has proposed several alternative configurations, including a truss-braced wing. The truss diagonally attaches to the underside of the wing and the belly of the fuselage.

By providing structural support, the truss allows the wing to be thinner and longer. Such shapes produce weaker wingtip vortices, which reduces induced drag, and increases the wing area covered by laminar flow, which leads to better aerodynamic efficiency. Despite the extra drag and weight caused by the diagonal truss, the improved wing can reduce overall fuel consumption by 5-10%, a joint NASA-Boeing study concluded earlier this year.

A truss-braced wing design is an “area of interest” as Boeing considers options for a flying ecoDemonstrator after 2020, Sinnett says.

“In the 2020 timeframe, if we were going to do a prototype then we’d have to be working on it, the design of it in the next two to three years,” Sinnett says. “If I were going to prioritise what I would want to know in that timeframe, I’d want to know as much about the high aspect ratio cantilever truss brace as I could and I wouldn’t necessarily want to throw a whole bunch of other stuff into the mix. So I would be looking at

a relatively simple tube but really trying to go after the benefits of a scaled up truss-braced wing.”

Mindful that market preferences can swing abruptly, Boeing is keeping its options open with more than five years remaining before a potential prototype becomes reality. Sinnett recalls how the economic impact of 9/11 caught the company’s product planners off guard, forcing them to switch from the Sonic Cruiser to the slower, more efficient 7E7 concept – renamed the 787 – in two years.

Any future ecoDemonstrator prototype will reflect the technology needed to support Boeing’s long-term product strategy. Sinnett cites developing regional, point-to-point markets as an example of how the company analyses its needs for

“Any future prototype will reflect the technology needed to support Boeing’s long-term strategy”

technology demonstrators. Ultra-long-range aircraft require higher speeds, which drives designers to look for improvements in swept-wing configurations. An aircraft optimised for regional flying, by contrast, has different performance drivers.

“In a regional market – if you’re trying to develop that – speed may not be as important and then alternate configurations with less swept wings start making more sense, because the speed doesn’t matter over shorter distances,” Sinnett says. “Depending on how the market plays out, that may or may not be an important thing if the emphasis in the next 10 years turns into more regional and medium-range routes.” ■



The improved wing can reduce fuel consumption by 5-10%



ANA used a biofuel blend on a 787 delivery flight in 2012, working with Boeing, which hopes it will make up 1% of overall fuel usage by 2016

FUELLING CHANGE

Gas turbine engines still have decades of technical improvement to come, but carbon-neutral aviation won't happen without a wholesale shift to biofuels

STEPHEN TRIMBLE PARIS

In 1971 – 34 years after the first ground test of Frank Whittle's prototype jet engine – General Electric's CF6 commercial turbofan engine entered service with the Douglas DC-10-10, representing a historic breakthrough in fuel efficiency.

The high bypass ratio of the CF6 meant that

the engine achieved most of its thrust by slowly accelerating a large volume of air around the engine core, rather than rapidly accelerating a small amount of air through the combustion process.

The concept appeared so profound that many of GE's engineers sincerely believed at the time that the CF6 had maximised the potential efficiency of the turbofan engine.

"When we were done, the guys said, 'Gee, we'll never do an engine this good again. This is the greatest engine we've ever done.' And they believed it. They really did," recalls GE Aviation president and chief executive David Joyce.

PLENTY OF ROOM

Forty-four years later, it's clear that even the breakthrough CF6 engine still left plenty of room for improvement. In two key measures of a turbofan engine's fuel efficiency, modern

"I have great confidence in our industry – not just in GE, but across the industry"

DAVID JOYCE

President and chief executive, GE Aviation

commercial engines offer roughly double the 5.3:1 bypass ratio and the 24:1 overall pressure ratio of the original CF6-6 engine.

The second-generation CF6-80C engine benefited from the invention of full-authority digital engine controls and from blades designed with 3D aerodynamic shaping. In the past decade, the GENx engine has replaced the CF6-80C2, with 15% better fuel efficiency, carbonfibre fan blades and fan case and a second-generation twin-annular pre-swirl combustor. That will be followed, in 2020, by a GE9X engine that should be 5% Boeing

more fuel efficient than the latest version of the GENx.

As the aviation industry looks ahead to ever-tighter restrictions on carbon emissions, Joyce believes the technology that enables fuel-efficiency improvements will continue to stay ahead of regulatory pressures.

"I have great confidence in our industry – not just in GE Aviation, but the technologists across the industry," he says.

Like any of its peers, GE has a technology roadmap that looks decades into the future, allowing the company to place bets on research funding priorities today. Expanding the use of ceramic and 3D-printed parts throughout the engine is high on the list, as is developing hybrid metallic structures.

But Joyce also points out that some of the biggest inventions are likely to come from technologies that have not yet been conceived. The next wave of engine improvements is likely to emerge as a result of analysing the massive volumes of data harvested from the fleet during and after each flight.

"The analytical tools are just so extraordinarily better now, and they will be better 10 years from now," Joyce says. "That gives us so much understanding of the physics and interactions that are occurring within the engine."

DECADES MORE

The gas turbine engine is a product of the Brayton cycle, which converts a mixture of air and fuel into energy through a simplified, four-step process involving suction, compression, combustion and diffusion. Nearly 80 years after Whittle and German Hans von Ohain separately invented the jet engine, no other means of propulsion can rival the efficiency and reliability of the gas turbine.

Despite that remarkable longevity, the gas turbine still has potentially many more decades of improvements ahead of it.

"I think there is as much headroom to improve in the gas turbine going forward as we have achieved since the first engine ran in 1937 in terms of fuel economy," says Alan Epstein, Pratt & Whitney's vice-president of technology and environment. "Do I know how to get there? No, because the old guys took all the easy problems and left us all the hard problems."

As a former director of the gas turbine laboratory at the Massachusetts Institute of Technology, Epstein also understands how the technology has evolved.

"Whittle's first jet engine was 10% efficient in converting fuel to pushing the airplane," he says. "The [PW1100G geared turbofan] going into service later this year is almost 40% efficient. Theoretically, the maximum [efficiency] is about 80%. I don't know how to get to 80%, but we're working on technologies for the next Pratt & Whitney GTF [that is due]

some time in the 2020s, if there will be an airplane to hang it on. I assume there will be one and that will be another 5%, 8%, 10%, 15% better, depending upon what gear we use."

The gas turbine has at least two and perhaps three more cycles of improvements before the Brayton cycle process reaches a theoretical limit. That point is still decades away, but engine companies and aircraft designers are already considering exotic concepts, such as hybrid turboelectric systems and unconventional airframe designs.

"The old guys took all the easy problems and left us all the hard problems"

ALAN EPSTEIN

Vice-president, P&W technology and environment

In the meantime, however, the aviation industry is probably going to face increasing pressure from regulators to cut emissions. Improvements in fuel efficiency could be offset by a predicted doubling of the commercial fleet over the next 20 years. Several industry officials accept gas turbine upgrades are still necessary, but not sufficient to meet regulatory demands.

"We need to decarbonise aviation," Epstein says. "That's really the imperative, to reduce aviation's contributions to the increase in [greenhouse gases]. A large part of that is better airplanes, and the engines that power them. The other part is going to low-carbon fuels."

Rising interest in biofuels is a key part of the industry's strategy to overcome rising carbon dioxide emissions. A more fuel-efficient fleet would reduce carbon emissions on a unit basis, but emissions will still grow in absolute

terms as the number of aircraft in service continues to rise. The way to solve that problem is to replace fossil fuels such as standard Jet A kerosene (burning it releases into the atmosphere carbon that had been trapped underground for millions of years) with biofuels, which are derived from new-growth plants or plant waste – and thus, when burned, release only carbon that had been absorbed from the atmosphere by the plants very recently.

"If at some point we are all on biofuel then the airplane's contribution to [atmospheric] carbon is neutral," says Mike Sinnett, Boeing's vice-president of product development. "Increased use of biofuels is one way the industry gets its carbon contribution under control."

Boeing has established a corporate goal of having biofuel contribute 1% of the aviation industry's overall fuel usage by 2016. The 1% objective carries more significance than the number would suggest. For the energy industry, a 1% measure in any market segment offers a proof of concept, suggesting such a fuel source could be a viable product. That helps drive the business case for investing in the harvesting, refineries and distribution networks necessary to expand the proportion of biofuels in the overall supply.

The industry's efforts to improve fuel efficiency must keep one step ahead of the regulatory demands. Aircraft and engine design is all about optimising performance at a broad level, with fuel economy traded against other criteria such as reliability and acquisition cost.

"The thing that we would worry about is suboptimisation of the whole process, where you get to the point where there is so much focus on improvements in one specific area that all other areas suffer as a result," Sinnett says. ■



GE's CF6 family is still in service; this 2015-delivered Airbus A330-200 is powered by CF6-80E1s

EMISSION STATEMENT

The aviation industry has a goal of carbon-neutral growth by 2020. Will a global market-based measure on emissions be agreed in time to meet the target?

KERRY REALS LONDON

Education, education, education. These three priorities, famously set out by former UK prime minister Tony Blair in the 1997 election campaign, could equally be applied to the ongoing campaign to convince the world to agree on a global market-based measure (MBM) to address aviation emissions.

The jury is still out, however, on whether the numerous seminars, webinars and information-sharing sessions taking place across the globe to educate states about the importance of such a measure will lead to the level of consensus needed to agree a proposal ahead of the autumn 2016 deadline.

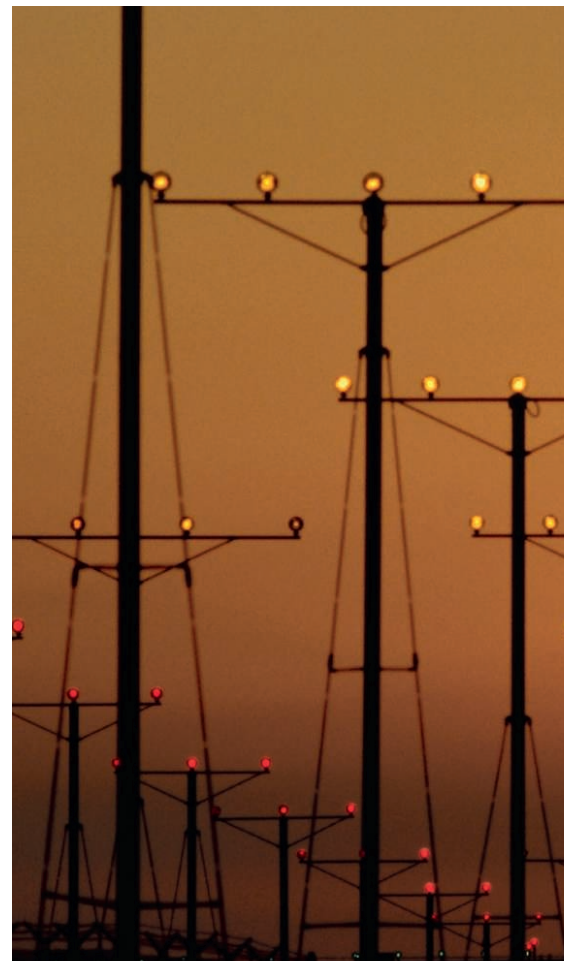
At the last triennial ICAO Assembly in September 2013, member states agreed to report back at the next Assembly in September 2016 with a proposal for a global MBM scheme for international aviation that could be implemented by 2020. Since then, tense negotiations have been taking place as countries in differing stages of development attempt to find a method of curbing emissions that is deemed fair by all.

ICAO announced in April that it had concluded its first round of global aviation dialogues (GLADs) on MBMs. These two-day sessions, says the UN body, were designed “to share information on MBMs and their potential role in mitigating [carbon dioxide] emissions from international aviation, update ICAO’s progress on the development of its global MBM scheme, and provide an important opportunity for feedback and discussion among member states and relevant organisations”.

DEFINED SHAPE

Five two-day GLADs were conducted in April, taking place in Cairo, Lima, Madrid, Nairobi and Singapore, and reaching 350 participants from 79 countries. A second round of GLADs is scheduled for next spring, by which point it is hoped the MBM proposal will have started to take on a more defined shape.

“The structure and format of the GLADs was designed to inform and engage non-[ICAO] Council states on the basics of MBMs to complement the basket of emissions mitigation measures ICAO is already pursuing,” said ICAO Council president Olumuyiwa Be-



The long-term goal is to cut carbon dioxide emissions to half of 2005 levels by 2050

nard Aliu on announcing the completion of the first round of GLADs.

ICAO says the highlights of its MBM dialogue sessions included “the simplicity and cost-effectiveness of a global scheme, the need for differentiation, and the goal of avoiding excessive cost or administrative burdens”.

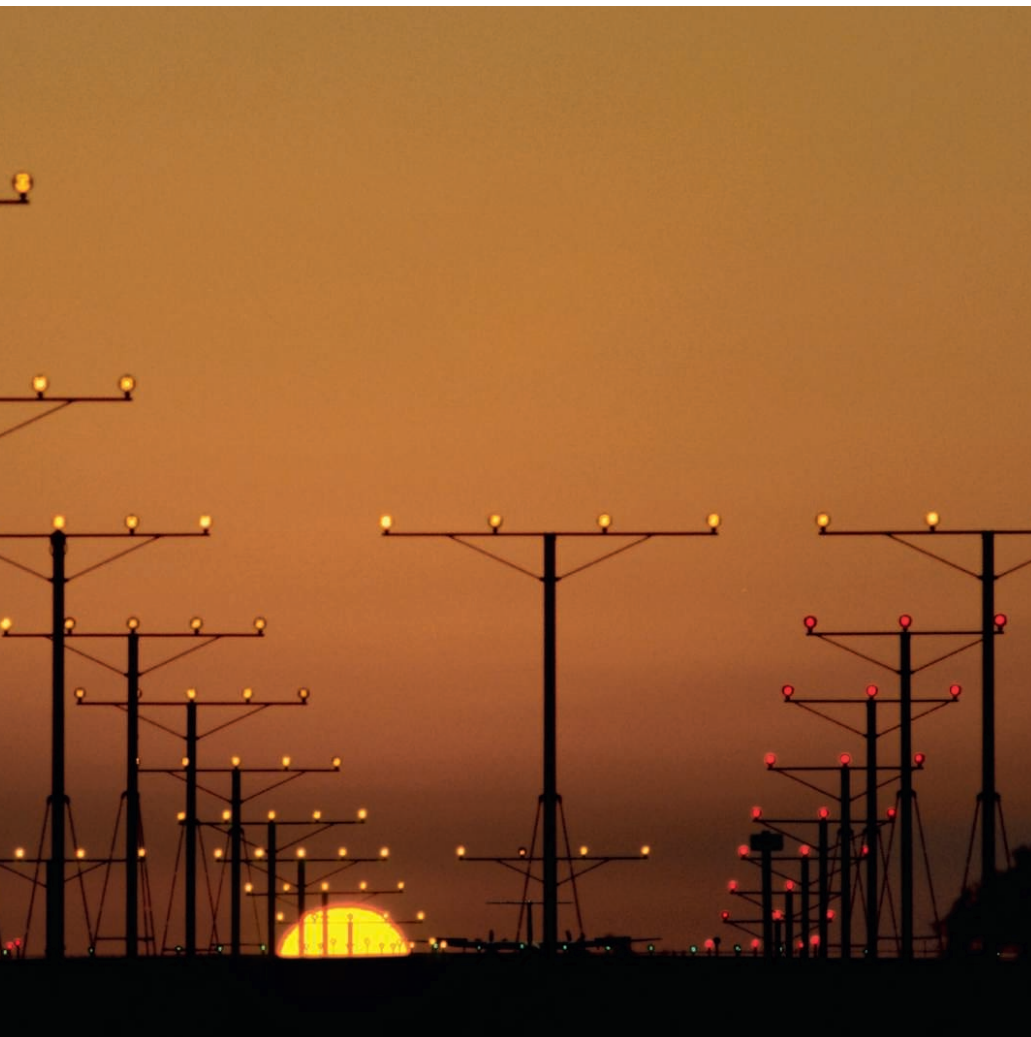
“Perhaps most importantly for us, the states who attended these first GLADs discussions left looking forward to the second round, when a concrete proposal for a global MBM scheme is expected to be on the table,” says Daniel Azema, ICAO’s head of cabinet. “States and other international organisations are very eager for more information on how our sector can improve its environmental footprint, and ICAO is just as eager to provide it to them.”

ICAO is also planning to host a seminar at its Montreal headquarters in September, entitled Global Aviation Partnerships on Emissions Reductions.

Alongside the educational sessions conducted by ICAO, the airline industry will be putting forth its own efforts to preach the benefits of adopting a global measure, as opposed to a patchwork of regional schemes. At the



Widespread use of sustainable fuels will be needed to meet aviation’s environmental objectives



forefront of those efforts will be IATA and the Air Transport Action Group (ATAG).

"There is a definite need for capacity-building – UN-speak for education – as to how the MBM will work, both for states and also for industry," says ATAG head of communications Haldane Dodd.

"It is something we and IATA will be concentrating on after the [Global Sustainable Aviation] Summit [in September], to make sure that all parties that will be included in any future MBM are aware of their responsibilities and know about the decision that will be coming up at the ICAO Assembly.

"So we will likely run a series of workshops or webinars for airlines as part of this process, with ICAO needing to do something similar for governments."

IMPORTANT FORUM

The ATAG Summit itself will take place 60 days before the UN climate change conference – COP21 – in Paris, and a year ahead of the crucial ICAO Assembly. The Geneva-based event will, therefore, provide an important forum for the airline industry to promote and clarify its position.



The MBM must be fair to developing countries

"The ATAG Summit is expected to have a focus on the development of the MBM, with high-level discussions on the ICAO process taking place alongside technical discussions on alternative fuels, noise and best environmental action," says Dodd. "Given that the global environment committees of IATA and ACI [Airports Council International] will also meet in Geneva during that week, it will be the chance for the industry to send a message to government negotiators in Paris and, more importantly for aviation, those meeting at ICAO."

IATA would prefer the MBM to take the form of a mandatory carbon-offsetting scheme to be applied to emissions growth post-2020,

using as a baseline the industry's average annual emissions between 2018 and 2020. Other options on the table include a revenue-generating carbon-offsetting scheme where funds raised would be used to help developing countries tackle climate change-related issues, and an emissions trading system along the lines of the EU's controversial ETS.

IATA environment chief Michael Gill acknowledges that there is much work to be done to convince the world that a single MBM would be in all parties' interests, but he is encouraged by the discussions that have taken place so far.

"I think that the progress in the negotiations on the global MBM is very encouraging. What has been striking is that many states who were previously reticent to move those

"I believe there is a desire to achieve a unique and historic agreement in 2016"

MICHAEL GILL

IATA environment chief

talks forward have now truly entered the discussions, participating actively in the exchange and putting forward new ideas and approaches," says Gill. "There remains a lot of work ahead of us but I genuinely believe that there is a desire on the part of governments the world over to achieve what would be a unique and historic agreement in 2016."

However, he admits that there are still many differences – particularly between developed and developing nations – on what form the MBM should take; hence the global education drive.

"The perennial issues of how to determine the obligations that would fall on individual operators in any future MBM scheme and how to reconcile the differing views of developed and developing states, including low-emissions states and emerging markets, remain on the table," says Gill.

While a global MBM is "vital" to help the aviation industry achieve its target of carbon-neutral growth from 2020, Gill points out that to reach the next objective of cutting carbon dioxide emissions by 50% by 2050, relative to 2005 levels, widespread use of sustainable aviation fuels will also be required. To this end, he wants governments to "recognise" the commitments that airlines have made to alternative fuels and "help bring production levels up so that prices can fall".

What is clear is that negotiators will have to work hard over the next 12 months to ensure that the first piece of the jigsaw – the global MBM – can slot into place. "We are within touching distance of achieving an agreement at the 2016 ICAO Assembly and we cannot afford to let our commitment flag," says Gill. ■

From yuckspeak to tales of yore, send your offcuts to murdo.morrison@flightglobal.com

Learmount's Great War

David Learmount, formerly of this parish and still contributing to *Flight International* as consulting editor, has launched a new blog (davidlearmount.wordpress.com) with the captivating tale of a trip to St Omer aerodrome, near Calais, where exactly 100 years earlier his grandfather, Second Lt Leonard Wright Learmount reported for active service with the Royal Flying Corps.

St Omer was the main RFC frontline base on the Western Front and is still active as an airfield. A British Air Services Memorial has recently been opened there.

David has unearthed some fascinating archives from his family history. His grandfather later became commander of his squadron and survived the conflict, unlike so many of his contemporaries. In 1916 he wrote a dispatch for a London newspaper, detailing in breathless, derring-do Biggles style some of his exploits at the front. "You can hear the zip of the Hun's bullets when they get close," reads one passage.

"LW Learmount was wounded twice, but his account is written in such a casual way that it is difficult to feel the danger, the fear, and to imagine the horrors he saw each day when he flew over battlegrounds like Passchendaele," notes D Learmount.

The blog entry includes photographs of his grandfather in Royal Air Force service after the war, and a copy of his log book, and makes for a very interesting read.

Lt Learmount's log, now on blog



Sir Tim: dropping into enemy territory

Recorder streamer Times shit VODEA

Un-appy ending

The above (we presume) typo was spotted towards the end of the exhibitors' new products and innovations list on the Paris air show app. We have no idea what it's meant to say either.

Not Sir Tim-id

We appreciate Sir Tim Clark probably likes to fly, especially on his own airline.

This week he is making the case for open skies in Washington DC – lair of the troika of airline bosses and their political allies, who would love to banish Emirates and its Gulf rivals from the Land of the Free – by hosting a live webcast.

A webcast? Er... couldn't he have done that from Dubai?

Qatar's cash

On the subject of the Gulf-US spat, the Doha-based carrier is usually accused of being handed lots of free money rather than the other way round (see right).

Top Dollar

The Lord may move in mysterious ways, but some of his servants, it seems, move in rather comfortable ways.

Remember Creflo Dollar, the US televangelist whose bid to raise \$65 million from his congregation to buy a new Gulfstream G650 was halted after a social media storm?

Dollar – it's his real name – who had released a video asking 200,000 followers to donate \$300, is going to get his jet after all. His ministry has raised the money and approved the purchase. Praise be!



Please take note

The best fuselage

In some notes written on the 10th September, 1913, I drew

100 YEARS AGO

attention to the advantages of a short fuselage, having

experimented exhaustively in this direction, and I pointed out that the chief advantage is quickness of recovery in the event of a dive.

Relief operation

Squadrons of Westland Lysanders, flying with great

75 YEARS AGO

daring, added to the epics of the defence of Calais by dropping water,

ammunition and hand grenades to the heroic garrison of Allied troops and marines. As they passed over the Citadel the pilots came down to as low as 50ft to make sure of their aim.

Down to Earth

The Gemini 4 mission came to a safe conclusion at 5.13

50 YEARS AGO

p.m. GMT on Monday, June 7, when the spacecraft

containing the two astronauts descended by parachute into the Atlantic some 400 miles south-west of Bermuda.

MiG-21s in action

The Cambodian Government has employed air power for

25 YEARS AGO

the first time against the resistance... led by Prince

Norodom Sihanouk. A MiG-21 dropped a single bomb on guerilla forces near the town of Staung, 160km north of Phnom Penh, according to the National Army of Independent Cambodia.

100-YEAR ARCHIVE
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FLIGHT INTERNATIONAL

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A solid battery of evidence

Can you thank Paul Burch for successfully missing the point (*Flight International*, 23-29 June)? Unfounded speculation as to an accident cause diverts attention from a well-defined risk in aviation which is now becoming prominent: lithium batteries as cargo in aircraft.

I was the investigator in charge of a UPS Boeing 747 accident caused by an onboard fire leading to loss of control in flight directly attributed to these products, spending two years testing the aircraft and the battery uncontained fire risk. There's no second-guessing with the facts: read the accident report.

No-one knows what happened to [Malaysia Airlines flight] MH370. Many commentators have speculated over deliberate crew action as a cause with no evidence, while not addressing the very real risk of a potential fire source that is on every aircraft flying. If you are going to speculate on an accident cause, back it up with tangible evidence.

The crew of MH370 have families, as well as the passengers. Put

IN-FLIGHT REFUELLING

Enough room for a boom?



Commonwealth of Australia

Are we nearly there yet?

With the arrival of the Airbus A330-300 (*Flight International*, 16-22 June), some interesting nonstop services are close to becoming possible and environmentally desirable – if not economically proven as yet.

The great circle distance from London Heathrow to Singapore is 5,878nm (10,900km) and the A330-300 has a range of over 6,000nm. Thus, a Singapore Airlines A330-300 modified to receive fuel from a boom could leave Heathrow with a full payload and receive sufficient fuel from a Singapore air force A330 MRTT somewhere over the Bay of Bengal to reach Sydney, Australia in one nonstop flight.

The distance from Singapore to Sydney is 3,400nm. This suggests that with a potential fuel giveaway of up to 80t, the MRTT could be co-ordinated to refuel a northbound flight from Australia in the same mission.

What premium would passengers and freight pay for a nonstop service between London and Sydney? And would Airbus consider modifying a standard or VVIP A330-300 to receive fuel from an MRTT?

Matt Wood, Range-Unlimited

Sandbach, Cheshire, UK

yourself in their shoes before making as-yet unprovable accusations.

Darren Straker

Abu Dhabi, United Arab Emirates

Firing discussion

Darren Straker suggests a cargo fire is a probable cause of the loss of MH370 (*Flight International*, 16-22 June). All explanations are speculation until wreckage is found, but it seems more likely than all the deliberate interference and conspiracy theories.

Research has shown a fire in an enclosed pallet of lithium-ion bat-

teries can become fully developed before any smoke warning, then explode, scattering incandescent material. This could disrupt the aircraft communication systems, either directly, or because the crew pulled circuit breakers in the belief the fire was of electrical origin.

Another risk is that the crew might think a fire warning is spurious. There was a hint of this in the total loss of [South African Airways flight] SA295 in 1987, where the cockpit recording shows it was the occurrence of two fire warnings that told the crew they had a real problem.

High humidity can cause false fire warnings – two such incidents were reported by the UK Air Accidents Investigation Branch in 2012. The interim Malaysian report says the aircraft carried 4,566kg (10,050lb) of mangosteen fruit, and that this was “of interest”. False warnings on the MH370 route may not have been rare.

Much work is going on to reduce cargo hazards, including in-pallet detection and suppression, so why speculate further about MH370? Unfortunately, the wreckage is yet to be found, and any scenario that altered aircraft performance or crew reaction would give a very different point of likely fuel exhaustion on the Inmarsat “seventh arc” to that currently assumed.

Richard Lloyd

Coventry, UK

Not a big fan

In your article about the UltraFan developed by Rolls-Royce and Liebherr (*Flight International*, 16-22 June), the author states that the fan will be driven by the intermediate compressor.

There is no way the compressor can generate energy to move the fan. Maybe he meant the intermediate pressure turbine?

Rodolfo A Serna

Bogota, Colombia

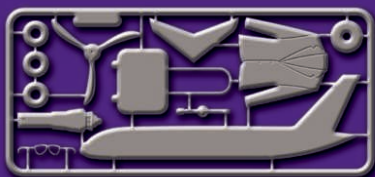
What's Boeing on with accounting?

Boeing is carrying forward enormous losses on its balance sheet relating to the 787 (*Flight International*, 28 April-4 May), thereby claiming profits it hasn't made.

Surely this cannot comply with European accounting laws? Any normal business writes off losses when they occur.

J McDermott

Hereford, UK



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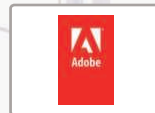
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**Quadrant House, The Quadrant,
Sutton, Surrey, SM2 5AS, UK**
flight.international@flightglobal.com

Editor Craig Hoyle
+44 20 8652 3834 craig.hoyle@flightglobal.com
Deputy Editor Dominic Perry
+44 20 8652 3206 dominic.perry@flightglobal.com
Head of Strategic Content Murdo Morrison FRAeS
+44 20 8652 4395 murdo.morrison@flightglobal.com
Features Editor Dan Thisdell
+44 20 8652 4491 dan.thisdell@flightglobal.com
Business & General Aviation Editor Kate Sarsfield
+44 20 8652 3885 kate.sarsfield@flightglobal.com
Aerospace and Defence Reporter Beth Stevenson
+44 20 8652 4382 beth.stevenson@flightglobal.com
Consulting Editor David Learmount
+44 7785 901787 david.learmount@btworld.com
Magazine Enquiries Dawn Hartwell
+44 20 8652 3315 dawn.hartwell@flightglobal.com

AIR TRANSPORT TEAM

Editor Flightglobal Premium News Graham Dunn
+44 20 8652 4995 graham.dunn@flightglobal.com
Managing Editor Niall O'Keeffe
+44 20 8652 4007 niall.okeeffe@flightglobal.com
Air Transport Editor David Kaminski-Morrow
+44 20 8652 3909 david.kaminski-morrow@flightglobal.com
Air Transport/MRO Reporter Michael Gubisch
+44 20 8652 8747 michael.gubisch@flightglobal.com
Senior Reporter Oliver Clark
+44 20 8652 8534 oliver.clark@flightglobal.com

AMERICAS

Americas Managing Editor Stephen Trimble
+1 703 836 8052 stephen.trimble@flightglobal.com
Deputy Americas Editor - Air Transport Ghim-Lay Yeo
+1 703 836 9474 ghimlay.yeo@flightglobal.com
Air Transport Reporter Edward Russell
+1 703 836 1897 edward.russell@flightglobal.com
Air Transport Reporter Jon Hemmerdinger
+1 703 836 3084 jon.hemmerdinger@flightglobal.com
Aviation Reporter James Drew
+1 703 836 7442 james.drew@flightglobal.com

ASIA/PACIFIC

Asia Editor Greg Waldron
+65 6780 4314 greg.waldron@flightglobal.com
Asia Air Transport Editor Mavis Toh
+65 6780 4309 mavis.toh@flightglobal.com
Asia Finance Editor Ellis Taylor
+65 6780 4307 ellis.taylor@flightglobal.com
Reporter Aaron Chong
+65 6780 4851 aaron.chong@flightglobal.com

EUROPE/MIDDLE EAST

Israel Correspondent Arie Egozi

FLIGHTGLOBAL.COM

Editor Stuart Clarke
+44 20 8652 3835 stuart.clarke@flightglobal.com
Web co-ordinator Rebecca Springate
+44 20 8652 4641 rebecca.springate@flightglobal.com

EDITORIAL PRODUCTION

Head of Design & Production Alexis Rendell
Global Chief Copy Editor Lewis Harper
Chief Copy Editor, Europe Dan Bloch
Layout Copy Editors Andy Hemphill, Sophia Huang, Tim Norman
Global Production Editor Louise Murrell
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DISPLAY ADVERTISEMENT SALES

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Sales Manager Shawn Buck
+44 20 8652 4998 shawn.buck@flightglobal.com
Key Account Manager Grace Hewitt
+44 20 8652 3469 grace.hewitt@flightglobal.com
Sales Support Gillian Cumming
+44 20 8652 8837 gillian.cumming@rbi.co.uk

NORTH & SOUTH AMERICA

Vice-President, North & South America
Rob Hancock +1 703 836 7444
robert.hancock@flightglobal.com
Regional Sales Director
Warren McEwan +1 703 836 3719
warren.mcewan@flightglobal.com
Sales Executive Kaye Woody
+1 703 836 7445 kaye.woody@flightglobal.com
Reed Business Information, 333 N. Fairfax Street,
Suite 301, Alexandria, VA 22314, USA

ITALY

Sales Manager Riccardo Laureri
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Laureri Associates SRL, Via Vallazze 43,
20131 Milano, Italy

ISRAEL

Sales Executive Asa Talbar +972 77 562 1900
Fax: +972 77 562 1903 talbar@talbar.co.il
Talbar Media, 41 HaGiva'a St, PO Box 3184, Givat
Ada 37808, Israel

ASIA/AUSTRALASIA

Key Account Manager Jay Ee
+65 6780 4301 jay.ee@flightglobal.com
Fax: +65 6789 7575
1 Changi Business Park Crescent,
#06-01 Plaza 8 @ CBP, Singapore 486025

RUSSIA & CIS

Director Arkady Komarov
komarov@worldbusinessmedia.ru
Tel/Fax: +7 (495) 987 3800
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Sales Manager Sophie Wild
sophie.wild@rbi.co.uk
Recruitment & Classified Key Account
Executive Katie Mann
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Stuart Lee +44 20 8652 4900
Classified.services@rbi.co.uk
Key Account Manager - Asia Jay Ee
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ADVERTISEMENT PRODUCTION

Production Manager Sean Behan
+44 20 8652 8232 sean.behan@rbi.co.uk
Production Manager Classified Alan Blagrove
+44 20 8652 4406 alan.blagrove@rbi.co.uk

MARKETING

Marketing Director Justine Gillen
+44 20 8652 8031 justine.gillen@flightglobal.com

DATA TEAM

Head of Data Pete Webber
+44 20 8564 6715
peter.webber@flightglobal.com
Commercial Aviation Steven Phipps
+44 20 8564 6797
steven.phipps@flightglobal.com
Defence & GA John Maloney
+44 20 8564 6704
john.maloney@flightglobal.com

PUBLISHING MANAGEMENT

Chief Operating Officer
Philippa Edward
Executive Director Content
Max Kingsley-Jones
max.kingsley.jones@flightglobal.com
Publisher Stuart Burgess
stuart.burgess@flightglobal.com

READER SERVICES

Subscriptions

Jenny Smith
Flight International
Subscriptions, Reed Business Information,
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Published by Reed Business Information Ltd, Quadrant
House, The Quadrant, Sutton, Surrey SM2 5AS, UK.
Tel: +44 20 8652 3500.

Newtrade distributed by Marketforce (UK) Ltd, Blue Fin
Building, 110 Southwark Street, London SE1 0SU, UK.
Tel: +44 20 3148 3300.

Classified advertising prepress by CCM.
Printed in Great Britain by William Gibbons and Sons Ltd.

Flight International published weekly 49 issues per year.
Periodicals postage paid at Rahway, NJ. Postmaster send
changes to Reed Business Information, c/o Mercury
International Ltd, 365 Blair Road, Avenel, NJ 07001

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ISSN 0015-3710 (Print) ISSN 2059-3864 (Online)

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17-19 July

Royal International Air Tattoo
RAF Fairford, Gloucestershire, UK
airtattoo.com

20-26 July

AirVenture Oshkosh
Oshkosh, Wisconsin, USA
eaa.org/en/airventure

6-7 August

Baltic Business Aviation Forum
Jurmala, Latvia
bbaf.aero/en/

25-30 August

MAKS
Moscow, Russia
aviasalon.com



Flight Safety Symposium
London, UK
flightglobalevents.com/
flightsafety Symposium2015

15-18 September

DSEI 2015
ExCel, London, UK
dsei.co.uk



Aviation Partnership Summit
Amsterdam, The Netherlands
flightglobalevents.com/APS15



**New Generation of Airline
Passenger Systems**
London, UK
flightglobalevents.com/pss2015

1 October

US Corporate Aviation Summit
Fort Lauderdale, Florida
aeropodium.com/uscas

1-2 October

Central Asian Aviation Symposium
Almaty, Kazakhstan
aeropodium.com/caa

6-8 October

Helitech International
ExCel, London, UK
helitechevents.com

20-21 October

The Commercial UAV Show
ExCel, London, UK
terrinn.com/exhibition/
the-commercial-uav-show

8-12 November

Dubai Airshow
Dubai World Central
dubaiairshow.aero

15-17 November

ALTA Airline Leaders Forum
San Juan, Puerto Rico
alta.aero/airlineleaders/2015

17-19 November

NBAA 2015
Las Vegas, USA
nbaa.org/events/bace/2015

17-19 November

Aerospace & Defense Meetings Torino
Torino, Italy
bciaerospace.com/turin

19-20 November

Safety In African Aviation
Kigali, Rwanda
2gether4safety.org



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Ref: DACAW/Delivery Financing/737-800/Senior/2015/253

Date: 16 June 2015

NOTICE: Request for Proposal (RFP) Senior Loan for Delivery Financing of 2(two) Boeing 737-800 aircraft

Biman Bangladesh Airlines Ltd. (Biman) has entered into an agreement with the Boeing Company ("Boeing") for the purchase of 2 (two) Boeing 737-800 aircraft ("the Aircraft") which are scheduled to be delivered on November 2015 and December 2015. Biman seeks offer from reputed financial institutions for Delivery Financing for the Aircraft in either of the following form:

(a) Invitation – Senior Commercial Loan ("the Senior Loan") Financing

The financing shall be in US Dollars for a 12 years term for up to USD 89.20 Million. The loan will be supported by a guarantee from the Government of Bangladesh. The form and structure of the loan and the guarantee will be as agreed with Biman and the Government of Bangladesh; or

(b) Invitation – Ex-Im Bank Guaranteed Loan Financing
Biman has submitted application to the U.S. Export-Import Bank ("Ex-Im Bank") for Guarantee support and Biman expects to receive the Final Commitment from the Ex-Im Bank by middle of July 2015. Basic requirements under this financing are mentioned below:

Purpose of Financing	Term loan to finance the senior portion of the net delivery price of aircraft plus 100% of Ex-Im Bank Exposure Fee.
Estimated Amount of Financing	Aggregate amount of Ex-Im Bank guaranteed financing including the exposure fee will be up to USD 89.20 Million.
Term of Guaranteed Loan	12 years from respective aircraft delivery dates.
Currency of Financing	US Dollars.

2. Offer may be made only for the Senior Loan referred under this RFP, or jointly for the Senior Loan and the Commercial Loan referred under a separate RFP ref: DACAW/Delivery Financing/737-800/ Commercial/2015/254 Date:16 June 2015.

3. Detailed information is available in the RFP Schedule, which may be viewed at Biman's website: www.biman-airlines.com. For further information or query, Controller of Accounts, Biman Bangladesh Airlines Ltd, may be contacted at Telephone: +8802-890-1590, Cell: +88-011-9042-0627, e-mail: controller@bdbiman.com during the office hours.

4. The Proposal / Offer should be submitted at the latest by 1000 hours BST (0400 hours UTC) on 30 July 2015 addressed to Controller of Accounts, Biman Bangladesh Airlines Ltd., Head Office, Balaka, Dhaka, Bangladesh through Courier Service or E-mail at finance-737-800-sl@bdbiman.com. The proposal(s)/offer(s) will be opened on the same day immediately after the closing time. No proposal/offer would be accepted after the closing time on the date specified above. Biman Bangladesh Airlines Ltd. would not be responsible for late receipt of any proposal/offer due to any reason whatsoever.

5. Biman Bangladesh Airlines Ltd. reserves the right to accept or reject any or all proposal(s)/offer(s) partly or wholly at any time and/or stage without assigning any reason whatsoever and no claim shall be entertained in this regard.

Controller of Accounts

Tenders



Ref: DACAW/Delivery Financing/737-800/Commercial/2015/254 Date: 06 June 2015

NOTICE:

**Request for Proposal (RFP)
Commercial Loan for Delivery Financing of 2
(two) Boeing 737-800 aircraft**

Biman Bangladesh Airlines (Biman) entered into an agreement with The Boeing Company ("Boeing") for the purchase of 2 (two) 737-800 aircraft ("the Aircraft") which are scheduled to be delivered in November 2015 and December 2015. Biman has already made the advance payments (i.e. Pre-Delivery Payment) required under the Boeing Purchase Agreement for the Aircraft. Delivery financing for Senior Loan of the Aircraft net price, on which first charge will be created, will be arranged as provided under the separate RFP (Ref: DACAW/Delivery Financing/737-800/Senior/2015/253 Date: 16 June 2015) titled as "Request for Proposal (RFP) Senior Loan for Delivery Financing of 2(two) Boeing 737-800 aircraft". The remaining amount of the net aircraft price will be financed either in the form of a subordinated loan with a second charge or purely commercial loan. Such a loan will be supported by a guarantee to be provided by the Government of Bangladesh.

2.Offer may be made only for the commercial loan referred under this RFP, or jointly for the commercial loan and the senior loan referred under a separate RFP: DACAW/Delivery Financing/737-800/Senior/2015/253 Date: 16 June 2015 titled as "Request for Proposal (RFP) Senior Loan for Delivery Financing of 2(two) Boeing 737-800 aircraft".

3. Basic requirements are mentioned below:

Purpose of Financing	Term loan to finance part of the net aircraft delivery price.
Estimated Amount of Financing	Aggregate amount of financing will be a maximum of USD 20.45 Million.
Term of Guaranteed Loan	Up to 12 years from respective aircraft delivery dates.
Currency of Financing	US Dollars

4.Detailed information is available in the RFP Schedule, which may be viewed at Biman's website: www.biman-airlines.com. For further information or query, Controller of Accounts, Biman Bangladesh Airlines Ltd, may be contacted at Telephone: +8802-890-1590, Cell: +88-011-9042-0627, e-mail: controller@bdbiman.com during the office hours.

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WORK EXPERIENCE JANNIE DE KLERK

When flying is a family affair

Jannie de Klerk is international operations manager for National Airways Corporation, providing charter, sales and leased fixed-wing aircraft and rotorcraft from Pretoria – and sometimes dealing with unhelpful authorities

How did you get started?

Both my mother and my father were pilots so it was the obvious thing to do. I always tell people that aviation is a way of life, not just a job. A person needs to live aviation, not just work in it. I have gone full circle on the training as far as ICAO safety and all the usual goes, but successful operations is mostly something you learn by experience. The best training I ever got came from the people I have worked with over the years and I continue to learn on a daily basis.

Where have you worked?

My first aviation job was as an operations manager in 1991 for two companies simultaneously: Avia Air Charter and Tropair Charter, based at Wonderboom airport outside Pretoria, South Africa. Tropair Charter specialised in flying charters in southern Africa for the tourist and corporate industries, while Avia Air Charter specialised in contract work, operating a large fleet of aircraft in Africa, including Douglas DC-3 Dakota turboprops, McDonnell Douglas DC-6s and Bombardier Learjets. From this I moved on to Debonair Tours as operations manager, operating DC-3 aircraft for the tourist and corporate industry in southern Africa, based out of Lanseria airport, Johannesburg. In 1997 I got involved in a new start-up charter business known as Naturelink Aviation. In 2010 Naturelink Aviation was sold to National Airways Corporation,



De Klerk was born in Pretoria, South Africa and works there still

one of the largest general aviation companies in Africa. I am currently the manager of international operations on the leasing side of the business within National Airways.

What is your company's mission?

We specialise in offering aviation solutions to our clients, including new and used aircraft sales, as well as leasing and charters of fixed-wing aircraft and helicopters. Our fixed-wing fleet consists of King Air series, Beechcraft 1900, Embraer EMB-120, and ERJ-145 and Hawker-series aircraft, throughout Africa and the Middle East. Our clients include the UN and the oil, gas and mining industries, as well as many corporate and commercial

"We are dealing with different countries with different regulations and cultures"

clients. Management of the international leasing fleet throughout Africa and the Middle East is my responsibility.

What do you focus on?

Getting more of our aircraft deployed into Africa and the Middle East for various missions. We face challenges on a daily basis in this business as we're dealing with different countries with different regulations and cultures.

Are authorities overly restrictive?

Dealing with incompetent authorities in the industry complicates the simplest of things. In Africa the authorities tend to think they serve purely a policing function and forget they are also there to help solve issues in the best interest of their customers, which are the operators. Dealing with authorities all over the globe on a regular basis, I believe this attitude seems to be a lot worse in Africa and is causing the industry to grow a lot more slowly than in other parts of the world. In Africa, for some reason, each authority has its own interpretations, and even within the same country the opinions of inspectors differ. Most people have the wrong opinion on how aviation is governed and do not realise that this is one of the most governed industries in the world. Companies such as National Airways Corporation pride themselves on having some of the highest accreditations in the industry and spend millions every year on continuous improvement to be a step ahead of our competitors. ■



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